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The Engineer

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The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES :—
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Assistant Engineer REQUIRED by the GOVERNMENT of HONG KONG for service in the PUBLIC WORKS DEPARTMENT for a period of three years, with possible permanency. Salary £460, rising to £600 a year by annual increments of £20 and thence, if appointment is made permanent, to £650 a year. The salary is converted into dollars at the Government rate of exchange, at present fixed at two shillings to the dollar, plus a temporary exchange allowance of 20 per cent. Cumyzance allowance of 240 dollars per annum is paid. Free passages provided. Candidates, unmarried, 24 to 30 years of age, must be fully qualified civil engineers with experience of drainage and sewer work and be conversant with modern sanitary appliances.—Apply at once by letter, stating age and giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at head of application M/13,158. 7129

Assistant Engineers (3) REQUIRED by the PUBLIC WORKS DEPARTMENT, FEDERATED MALAY STATES, for four years' service, with possible permanency. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but the purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. Free passages provided. Candidates, age 25 to 35, preferably unmarried, must have received a good theoretical training, preferably at a University or an Engineering College recognised by the Institution of Civil Engineers, or have completed articles with a civil engineer of good standing and have passed the examination for Associate Membership of the Institution of Civil Engineers. Possession of an engineering or science degree preferred. In addition to pupilage, must have had at least one year's practical experience in the design and execution of works of some considerable magnitude. A knowledge of modern road-making and maintenance is desirable.—Apply at once by letter, giving brief details of qualifications and experience, and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at head of application M/13,142. 7088

Assistant Locomotive SUPERINTENDENT REQUIRED for the NIGERIAN GOVERNMENT RAILWAY for two tours of from 12 to 18 months' service, with prospect of permanency. Salary £480 a year for the first three years, then £510, rising by annual increments of £30 to £720 and thence by annual increments of £40 to £800. Outfit allowance of £60 on first appointment. Free quarters and 1st class passages and liberal leave on full salary. Candidates, age 25 to 35, should be of good education and preferably possess an approved Engineering Diploma. They should have had a thorough training in the workshops of a British railway or well-known locomotive firm, should be conversant with the repair and erection of locomotives, carriages and wagons, and be well-up in drawing-office work and have had running experience. Preference will be given to applicants who have acted in a supervising capacity.—Apply at once by letter, stating age and particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/Nig. 18,150. 7130

Assistants (Three) REQUIRED by the GOVERNMENT of HONG KONG for service in the Architectural Office of the PUBLIC WORKS DEPARTMENT for a period of three years, with possible permanency. Salary £460, rising by annual increments of £20 to £500 a year and thence (if appointment is made permanent) to £650 a year, payable locally in dollars at the Government rate of exchange, which is at present fixed at 2s. to the dollar. In addition a strictly temporary exchange allowance of 20 per cent. of salary is at present paid, and thus at the present time the annual salary in dollars will be 5520 dollars a year. The current rate of exchange being now about 2s. 5d. to the dollar, the sterling equivalent of 5520 dollars is accordingly about £667 a year. No income tax payable. Candidates, unmarried, 24 to 32 years of age, must be duly qualified architects' assistants and Associates of the R.I.B.A., should have experience in design and the preparation of working drawings, details and specifications, and have some knowledge of quantities. Experience in the design and erection of steel-framed buildings and a working knowledge of reinforced concrete is desirable.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/13,019. 7165

Appointments Board OF THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY,
Including :
ROYAL COLLEGE OF SCIENCE,
ROYAL SCHOOL OF MINES,
CITY AND GUILDS (ENGINEERING) COLLEGE,
SOUTH KENSINGTON, S.W. 7.
EMPLOYERS REQUIRING MEN who have received a thorough training in the principles of Engineering and who have obtained the Diploma of the City and Guilds (Engineering) College are asked to make use of the services of the Board. No fees.
These men have received instruction (including practical work in the extensive and well-equipped laboratories of the College) in Civil, Mechanical and Electrical Engineering, including Mathematics, Physics, and Chemistry. Their training has been such that they are capable of specialising in any branch of Engineering that may be offered. 7077

PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that CLAUDIO GALLO, of 9, Via Saluzzo, Turin, Italy, SEEKS LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 210,597, entitled "Improvements relating to the Operation of the Valves of Internal Combustion Engines."
Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) issued on the 24th September, 1924.
Any person, or persons, may give notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. TEMPLE FRANKS,
7090 Comptroller-General.

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that BUCYRUS COMPANY, a corporation of the State of Wisconsin, having a place of business at South Milwaukee, State of Wisconsin, United States of America, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 13,556 of 1911, granted to THOMAS THRALL PARKER for "Improvements in and relating to Steam Boilers."
Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) issued on the 24th September, 1924.
Any person, or persons, may give notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
(Sgd.) W. TEMPLE FRANKS,
7125 Comptroller-General.

Administrative County of LONDON.
VICTORIA EMBANKMENT SUBWAY.
The London County Council invites TENDERS for the CONSTRUCTION of TWO STAIRWAYS to the existing Subway under the Victoria Embankment near Westminster Bridge.
Persons desiring to submit Tenders may obtain the drawings, specification, form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, upon payment of £3, which will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the drawings, specification and other contract documents may be inspected before the payment of the fee.
No Tender received after 4 p.m. on Monday, 13th October, 1924, will be considered.
The Council does not bind itself to accept the lowest or any Tender.
JAMES BIRD,
7103 Clerk of the London County Council.

Egyptian State Railways.
SUPPLIES are REQUIRED of :—
1. FLAT BOTTOM RAILS.
2. BOLTS and NUTS for FISH PLATES.
3. COACH SCREWS.
4. STEEL FISH-PLATES and ANGLED STOPS.
5. SADDLES.
Specifications can be obtained from the INSPECTING ENGINEER, Egyptian and Sudan Governments, Queen Anne's Chambers, Westminster, London, S.W. 1, at the price of 8s. each copy for each class of material.
Adjudication will take place in Cairo for the first two items on the 27th October and the last three items on the 29th October. 7111

PUBLIC NOTICES

Christchurch Union.
LAUNDRY MACHINERY AND EQUIPMENT.
The Guardians invite TENDERS for EXTENSIONS and ALTERATIONS in connection with their LAUNDRY EQUIPMENT.
The work includes the Supply and Fixing of several different makes of Laundry Machines, Millwrighting, Steam and Water Pipe Work, Electric Wiring, &c. Only firms who have carried out several large installations of a similar nature should make application for Tender forms.
Specifications, conditions of contract, and drawings may be inspected at the Union Offices of the above Guardians and copies of the specification, drawings, and Tender form may be obtained on payment of a deposit of Two Guineas, which will be returned after the receipt of a bona fide Tender.
Applications for Tender forms must be received on or before the 8th instant.
Sealed Tenders, endorsed "Laundry Equipment" and addressed to me, the undersigned, to be delivered not later than Noon on the 20th instant.
The Guardians do not bind themselves to accept the lowest or any Tender.
PERCY C. FORD,
Clerk to the Guardians.
Fairmile House, Christchurch, Hants,
2nd October, 1924. 7097

County Borough of South- AMPTON.
TO CONTRACTORS AND OTHERS.
The Corporation invite TENDERS for LAYING and JOINTING about 2000 YARDS of 24in., and about 6250 YARDS of 30in. C.I. WATER MAINS from Otterbourne Reservoir to Hampton Park.
Plans may be seen and specification, bill of quantities and form of Tender obtained from the Waterworks Engineer's Office, 21, Shirley-road, Southampton, upon production of the Borough Treasurer's receipt for a deposit of £3 3s. Deposits will be returned after the Council have dealt with the Tenders to contractors who have submitted bona fide Tenders and returned all documents supplied.
Sealed Tenders, suitably endorsed, must be delivered at the Town Clerk's Office, Municipal Offices, Southampton, by the 17th October, 1924.
No pledge is given to accept the lowest or any Tender.
R. B. LINTHORNE,
Town Clerk.
20th September, 1924. 6974

The Madras and Southern MAHRATTA RAILWAY COMPANY, LTD.
The Directors are prepared to receive TENDERS for :
(i.) 2 LOCOMOTIVE ENGINES and TENDERS (Standard Passenger Superheated 4-6-0 Type), Metre Gauge ;
(ii.) 2 FIVE-TON OVERHEAD ELECTRIC TRAVELLING CRANES ;
(iii.) CANVAS, comprising 322 Yards GREEN CLOTH for LAMP SHADES and 6000 Yards NAVY SAIL CANVAS ;
in accordance with the specifications, which may be seen at the offices of the Company. The charge for each of the specifications is One Guinea, which will not be returned. Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 21st October, 1924, and marked "Tender for Locos." or as the case may be.
The Directors do not bind themselves to accept the lowest or any Tender.
Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1.
30th September, 1924. 7119

PUBLIC NOTICES

Port of Bristol.
RECONSTRUCTION OF SWING BRIDGE, JUNCTION LOCK, CUMBERLAND BASIN, BRISTOL.
The Docks Committee invite TENDERS for the RECONSTRUCTION of the SWING BRIDGE over the Junction Lock, Cumberland Basin, Bristol. The work in the contract is to include foundations, abutments, steel work, and opening and closing machinery. Building contractors will be allowed to sublet the steel work and the machinery. Bridge construction contractors will be allowed to sublet the building work and the machinery. Tenders must, however, include for the whole of the work.
On and after Monday, the 29th day of September, 1924, copies of the specification, &c., can be obtained from the undersigned on production of a receipt to the undersigned showing that a deposit of £5 has been paid to the Bristol Docks Committee, to whom all cheques must be sent and made payable. The deposit will be returned to bona fide tenderers after the receipt of the Tender with all the prescribed documents and drawings.
Tenders must be enclosed in a sealed envelope, endorsed "Tender for Reconstruction of Swing Bridge, Cumberland Basin, Bristol," and addressed to the General Manager and Secretary of the Docks Committee, 19, Queen-square, Bristol, and must be delivered to him, accompanied by all the prescribed documents and drawings, before 10 a.m. on Monday, the 27th day of October, 1924.
The Docks Committee do not bind themselves to accept the lowest or any Tender.
THOMAS A. PEACE,
Chief Engineer.
Chief Engineer's Office,
Avonmouth Dock, Bristol,
24th September, 1924. 7017

The Fylde Water Board.
HODDER SCHEME.—AQUEDUCT NO. 5.
The Fylde Water Board invite TENDERS from contractors experienced in this class of work, for LAYING the following LENGTHS of CAST IRON MAIN between Stocks Reservoir in the West Riding of the County of York, and Westby Reservoir, near Blackpool, in the County of Lancaster, including the CONSTRUCTION of MANHOLES, BRIDGE ABUTMENTS, and all incidental Works.
SECTION 1.—12,919 Yards of 27in. Main.
SECTION 2.—12,518 Yards of 27in. Main.
SECTION 3.—12,846 Yards of 25in. Main.
SECTION 4.—12,260 Yards of 25in. Main.
Particulars, specification, and bills of quantities, with forms of Tender, may be obtained from the undersigned. Applications must be accompanied by a fee of Five Guineas, which will be returned on receipt of a bona fide Tender.
Plans may be viewed by appointment at the Engineer's office.
The Board reserve the right to accept the lowest, whole of, or any Tender.
Tenders must be received by the undersigned on or before Friday, October 31st, 1924.
GEO. F. ATKINSON,
Engineer.
The Fylde Water Board,
Sefton-street, Blackpool,
23rd September, 1924. 7005

ROTHLEY, NEAR LEICESTER.
SEWAGE WORKS.

The Barrow-on-Soar Rural Dis- TRICT COUNCIL are prepared to receive TENDERS for the CONSTRUCTION of about 5000 YARDS of 6in., 7in., 8in., and 12in. STONEWARE PIPE SEWERS and about 3000 YARDS of 5in., 7in., and 9in. CAST IRON PIPE SEWERS, together with MANHOLES, and of a MAIN PUMPING STATION, SUBSIDIARY PUMP CHAMBER, SETTLING TANK, CONTINUOUS FILTERS, and DISTRIBUTION WORKS of the Parish of Rothley, in the County of Leicester.
The work is to be carried out with assistance from the Unemployment Grants Committee.
"75 per cent. of the men employed are to be engaged from Leicester and/or Loughborough and an active start is made prior to October 31st, 1924." A fair wages clause will be inserted in the contract.
The drawings may be seen at the offices of the Engineers, Messrs. Pick, Everard, Keay and Gimson, 6, Millstone-lane, Leicester, from whom conditions, specification, quantities, and form of Tender may be obtained on payment of £2 2s., which sum will be returned on receipt of a bona fide Tender.
Sealed Tenders, on the form supplied, must reach the undersigned not later than Ten o'clock in the forenoon of Tuesday, the 21st day of October, 1924, endorsed "Tender for Rothley Sewerage."
The Council do not bind themselves to accept the lowest or any Tenders.
THOS. FORWARD,
7122 Clerk to the Council.

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PUBLIC NOTICES

Urban District of Cirencester.

The Urban District Council of Cirencester invite TENDERS for the CONSTRUCTION, ERECTION and MAINTENANCE of a GAS ENGINE, SUCTION GAS PRODUCER, and BOREHOLE PUMP, to lift 15,000 gallons of water per hour, with all the necessary adjuncts, at the Waterworks Pumping Station, Lewis-lane, Cirencester.

Copies of the specification and of lay-out plan can be obtained on payment of a deposit of £5 (which will be returned on receipt of a bona fide Tender) at the office of the Surveyor at the Council Offices, Cirencester, or at the offices of the Consulting Engineer, Mr. E. J. Silcock, M. Inst. C.E., 25, Victoria-street, Westminster, and 10, Park-row, Leeds.

Sealed Tenders, endorsed "Tender for Pumping Plant," must be delivered to the undersigned at his office not later than first post on October 21st, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

R. W. ELLETT,
Clerk to the Council.

Council Chambers, Castle-street, Cirencester, 25th September, 1921. 7079

County Borough of Darlington.

APPOINTMENT OF SUPERINTENDENT OF WATERWORKS AND PUMPING STATION.

The Darlington Town Council invite APPLICATIONS from qualified persons for the APPOINTMENT of SUPERINTENDENT of WATERWORKS and PUMPING STATION, at a salary in accordance with and subject to the terms and conditions of the Corporation's scale for the clerical and administrative staff, of £235 per annum, rising to £250 after one year's service, together with house and garden (rent and rates free), coal and lighting.

The person appointed will be required to act under the direction of the Waterworks Engineer, and preference will be given to applicants who are skilled engineers with experience in steam and electrically driven pumping plants, suction gas engines and mechanical filters, and able to execute repairs.

The position is a designated post under the Local Government and Other Officers' Superannuation Act, 1922, which has been adopted by the Council, and whoever is appointed will be subject to the provisions of such Act.

A list of duties and conditions of the appointment may be obtained on application to the Borough Surveyor and Waterworks Engineer, Town Hall, Darlington.

Applications, endorsed "Waterworks Superintendent," accompanied by three recent testimonials, should be delivered to the undersigned not later than the 18th day of October, 1924.

H. G. STEAVENSON,
Town Clerk.

Houndgate, Darlington, 25th September, 1924. 7071

Municipality of Colombo, Ceylon.

APPOINTMENT OF AN ASSISTANT ENGINEER.

The Colombo Municipal Council REQUIRES the SERVICES of an ASSISTANT ENGINEER.

Candidates must have passed the A.M.I.C.E. or other equivalent examination. Preference will be given to those who have had experience in all branches of Municipal Engineering and to unmarried candidates.

The salary attached to the post is Rs. 7200 a year, rising by annual increments of Rs. 360 (beginning from a year after the date of appointment) to Rs. 10,800, together with a travelling allowance of Rs. 1200 a year, provided that a motor car is kept for the purpose.

The selected candidate will be required to enter into an agreement to serve the Council for a period of three years. At the end of the three years, if the officer has carried out his duties to the satisfaction of the Council, he will be appointed to the permanent staff, with leave and pension rights according to Council's regulations.

Medical examination as to fitness for service in the East is required.

Free passage to Colombo by first-class intermediate or second-class mail steamer will be provided with half pay during the voyage out.

Application forms and further details can be obtained from the Council's London Agents, Messrs. JOHN POOK and CO., 68, Fenchurch-street, London, to whom candidates should forward their applications before 15th October, 1924.

The Town Hall, Colombo,
26th August, 1924. 6988

SITUATIONS OPEN

WANTED, ASSISTANT to HEAD of PUBLICITY DEPARTMENT, age 25-30. Good education and engineering training; thoroughly experienced in copy writing for advertisements and technical catalogues, photography and block making and all branches of advertising.—Address, giving fullest particulars of training, experience, firms worked for, and wage required, 7092, The Engineer Office. 7092 A

WANTED, ENGINEER for Foreign Sales Department. Well educated, good practical and technical training, also selling experience. French and commercial experience abroad essential.—Address, giving full particulars of age, experience, and salary required, 7093, The Engineer Office. 7093 A

WANTED, FOUNDRY ORGANISER for Eastern Counties, capable of getting the best out of Foundry Moulding Machinery. Sand experience.—Address, 7121, The Engineer Office. 7121 A

ASSISTANT ENGINEER WANTED, to Act as SUPERVISOR and CHECKER between Works and Office. Used to engineering drawings. Good manager of men and output. North-East London district.—Address, stating age and experience, 7120, The Engineer Office. 7120 A

CIVIL ENGINEERING ASSISTANT.—A FIRM of CONSULTING ENGINEERS REQUIRES AT ONCE a competent ENGINEERING ASSISTANT, with a large experience in the design and execution of modern Sewerage and Sewage Disposal and Water Supply Works.—Replies (which will be treated in confidence), giving experience, salary required, age, &c., to be addressed 7095, The Engineer Office. 7095 A

ENGINEER-IN-CHARGE. Thoroughly Capable, for Woodworking Factory, London, N.E. (40 hands). Able to drive 100 H.P. gas engine and take full charge. First-class references.—Address, 7126, The Engineer Office. 7126 A

ENGINEER WANTED, Hampshire District, Take Charge First-class Engineering Shop equipped modern tools. Must be thoroughly capable producing all kinds metal fittings, mostly of small dimensions to very fine limits. Essential should be good organiser and able to handle men to ensure quick production.—Address fullest particulars, 7119, The Engineer Office. 7119 A

ESTIMATOR.—REQUIRED by Old-established Firm in S.E. London, JUNIOR ASSISTANT in Estimating Department. Applicants must have knowledge of Centrifugal Pumps and Electrical Machinery, commercial experience and knowledge of estimating essential.—Address, stating age, experience, and salary required, 7100, The Engineer Office. 7100 A

STRUCTURAL DETAILER REQUIRED; Must be quick and accurate.—Write, stating age, experience, and salary required, to FRASER and CHALMERS ENGINEERING WORKS, Erith. 7090 A

THE BRITISH REINFORCED CONCRETE ENGINEERING COMPANY REQUIRE the SERVICES of TWO JUNIOR TRAVELLERS, with a knowledge of Reinforced Concrete Construction. Previous travelling experience not essential, but applicants must be of good appearance and address and have an aptitude for the commercial side of business. Replies, stating age, qualifications, and salary required, should be marked "Junior Travellers" and addressed to 1, Dickinson-street, Manchester. 7099 A

SITUATIONS OPEN (continued)

REQUIRED for British Engineering Works in India, an ENGINEER as SENIOR ASSISTANT to the Management, experienced in Bridge and Steel Constructional Work. Applicants must have had workshops, drawing-office, designing and estimating experience. Age 34 to 38.

Apply, stating age and giving full particulars of previous experience, to Z. D. 560, care Deacon's Advertising Offices, Leadenhall-street, London. 7014 A

WANTED, Experienced DRAUGHTSMAN, Used to Hydraulic Cranes and Structural Work.—Apply by letter only, stating age, experience, and salary required, to the HYDRAULIC ENGINEERING CO., Ltd., Chester. 7084 A

CHIEF DRAUGHTSMAN, to Take Charge of Staff of twelve; capable organiser and fully experienced in quick and accurate estimating for structural and chemical plant. Give full details of past experience, age, salary required.—Address, 7075, The Engineer Office. 7075 A

DRAUGHTSMAN, JUNIOR, WANTED by Firm in Midlands. Must have good knowledge of Electric Overhead Cranes, Wharf Cranes, &c.—Apply by letter, 7083, The Engineer Office, stating experience and salary required. 7083 A

DRAUGHTSMAN, Midlands; Machine Tool or Textile estimating experience an advantage.—Address, 7074, The Engineer Office. 7074 A

DRAUGHTSMAN WANTED for Machine Arrangements and Details. Near N.W. London. State age, experience, and salary.—Address, 7124, The Engineer Office. 7124 A

EXPERIENCED DRAUGHTSMAN for Dust Removal Schemes and preferably with knowledge of Fan application.—Age, salary and experience to Box 213, c/o Mather and Crowther, Ltd., 10, New Bridge-street, E.C. 4. 7087 A

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED, for North-East Coast. Must have had experience on Heavy Bridge Work, Foundations, Buildings, &c.; designing, preparing drawings for shops and estimating. State salary required. Others need not apply.—Address, 6305, The Engineer Office. 6305 A

FIRST CLASS STRUCTURAL DRAUGHTSMEN REQUIRED; none but experienced men need apply. State full particulars, age, salary required.—THE CLEVELAND BRIDGE and ENGINEERING CO., Ltd., Darlington. 6799 A

INDIA.—STRUCTURAL DRAUGHTSMAN.—Young unmarried MAN REQUIRED, with good practical experience of Bridge and Light Structural Work and sound knowledge of the theoretical side. Good opening for capable man with initiative.—Apply, with full details of training and experience and copies of testimonials, and stating salary required, to Z.K. 616, c/o Deacon's Advertisement Offices, 7, Leadenhall-street, London, E.C. 3. 7104 A

MECHANICAL DRAUGHTSMAN for the S.E. London district, preferably one experienced in the design of Telegraph Instruments and Small Mechanical Movements. State age, experience, and salary required.—Address, 7073, The Engineer Office. 7073 A

REQUIRED, First-class STRUCTURAL and MECHANICAL DRAUGHTSMAN, with up-to-date experience in the design and lay-out of Conveying and Elevating Plants and Steel Structures.—Write, stating age, experience, and salary required, to FRASER and CHALMERS ENGINEERING WORKS, Erith. 7089 A

REQUIRED IMMEDIATELY for India, STRUCTURAL DRAUGHTSMAN, age about 24-30. Must be competent work out stress diagrams, design Steel structures, also all-round first-class constructional knowledge. Colliery plant experience an advantage. Salary Rs. 600 monthly, including quarters.—Write, stating age, experience, &c., to Box L.T., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 7091 A

TEMPORARY LEADING DRAUGHTSMAN REQUIRED with general engineering experience, to Take Charge of Small Drawing-office. Also a TEMPORARY JUNIOR. State age, experience, and salary expected.—Address, 7078, The Engineer Office. 7078 A

WORKING FOREMAN ENGINEER REQUIRED at the London County Mental Hospital, Bexley, Kent. Age not to exceed 40 years. Candidates must be thorough mechanics, accustomed to general work, able to control men, capable of carrying out repairs to steam engines, dynamos, motors, deep-well and other pumps, &c., and must have had experience in responsible charge of a main electric lighting station or of a lighting and power plant. Wages at present £6 11s. 9d. a week (subject to variation depending on cost of living) and unfurnished house (rates, taxes and water supply free). Pensionable. Appointment subject to medical examination. Preference will be given to candidates who served or offered to serve with H.M. Forces during the late war.

Full particulars on form of application obtainable from the CHIEF OFFICER, Mental Hospitals Department, County Hall, Westminster Bridge, S.E. Stamped addressed foolscap envelope to be enclosed. Canvassing disqualifies. Applications must be received not later than 10 a.m. on Friday, 10th October, 1924. 7102 A

SITUATIONS WANTED

BUYING ENGINEER. Long and Valuable Experience with largest manufacturing concern, very considerable technical knowledge of materials, familiar with all sources of supply, is DESIRING NEW APPOINTMENT. Is a keen organiser and experienced administrator.—Address, P9639, The Engineer Office. P9639 B

ENGINE DESIGN (Internal Combustion).—DESIGNER, holding responsible post, DESIRES ADVANCEMENT in a similar capacity or as TECHNICAL ASSISTANT.—Address, P9645, The Engineer Office. P9645 B

SITUATIONS WANTED (continued)

ENGINEER, Mechanical, WANTS WORK. Try anything. Draughtsman, commercial and advertising experience; good knowledge modern methods oxy-acetylene cutting.—T., 14, Grange-road, S.E. 19. P9634 B

ENGINEER, 20 Years' Broad Engineering and business experience with large industrial corporations, DESIRES responsible POSITION with progressive firm. Mechanical and structural plant, expert in American-made shovels and drag-lines. Chief Engineer, Assistant Executive or Representative Engineer. Initiative and good personality; 15 years' foreign experience; speaking Hindustani and Burmese. Age 36.—Address in first instance, P9647, The Engineer Office. P9647 B

FOUNDRY RATE-FIXER SEEKS POSITION. Automobile, gas, oil, steam and jobbing; foundry experience in iron and aluminium. Previous appointments 8, 9, and 2 years respectively.—Address, P9629, The Engineer Office. P9629 B

MARINE ENGINEER, All-round Foreman of 20 years' experience, is OPEN for SITUATION at home or abroad, either as Supt. Engineer, Shop or Outdoor Foreman; would consider offer to take up commercial line of engineering products. Excellent references.—Address, P9638, The Engineer Office. P9638 B

MECH. ENGINEER (24), 4 Yrs' College, Diploma mechanical engineering, good experience various shops and D.O., SEEKS SITUATION. Low salary for progressive berth.—Address, P9631, The Engineer Office. P9631 B

MECH. ENG. (25), 3 Yrs. Shop, 6 Yrs. Tool-room fitting, 1 yr. D.O. and rate fixing, secondary and continued education, R.O.F. trade lad, DESIRES SITUATION.—Address, P9630, The Engineer Office. P9630 B

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Irish Water Power and German Engineers.

Last March considerable curiosity and amazement were excited not only in this country but in the Irish Free State itself over the details of the Free State Government's dealings with a German firm—the Siemens-Schuckert Company of Berlin—concerning the hydro-electric development of the river Shannon. The agreement entered into provided various alternatives which would have secured to the Berlin firm at least the positions of consulting engineers and sole contractors for the machinery. The company was to receive the Free State Government's assistance in making a survey of the river, and its scheme when prepared was to be submitted to certain experts of European reputation at the Government's expense. It would appear that the company has now completed its survey and drawn up its scheme, for it has been officially announced that the committee of experts is about to proceed at once with its task, for which purpose it was to assemble in Dublin this week. The committee, it is intimated, consists of MM. Waldemar and Borgquist of Stockholm, M. Schuls of Christiania, and Professors Rohn and Peter of Zurich.

Irrigation Works in Irak.

Before the war an important project for the irrigation of the Irak division of Mesopotamia was begun by Sir John Jackson, Limited, for the Turkish Government. The outbreak of hostilities brought activities to a stop, and on the death of Sir John Jackson the scheme was allowed to lapse. Recently a new concession was sought by a local group, and Sir Thomas Ward, late Director of Irrigation in India, together with an expert staff, was appointed to investigate the scheme afresh. The investigations showed that the country possessed possibilities for the growing of cotton at least as great as those of Egypt or the Soudan. Over two million acres of highly productive cotton-growing land, it was estimated, could ultimately be made available for an expenditure of £17,000,000 on development work. Sir John Norton Griffiths, of Norton Griffiths and Co., Limited, public works contractors, Westminster, has, it is understood, now associated himself with the scheme. On the recommendation of the investigators it is intended, we gather, to begin with the development of immediately productive areas under a scheme involving the expenditure of something less than half a million sterling.

Colonel Pringle's Annual Report.

The report of Colonel Pringle on the railway accidents of 1923, although dated July 24th, did not appear until Friday last, nearly two months later than usual. The points of immediate interest are as follows. The serious collision at Retford, in which a locomotive inspector was a passenger on the footplate, afforded no ground for support of the argument that an advantage in respect of observation of signals would be obtained by the presence of a third man on the footplate. Automatic train control would have prevented this and two other accidents. The conclusions of the railway companies' committee on this subject have not yet been received. Track circuit would have prevented three collisions, and in five cases the use of a continuous brake on freight trains would have prevented the accident or ameliorated the results. Out of 25 recommendations made by the inspecting officers 18 have been wholly or partially adopted, one was rejected, and the remaining six are still under consideration. A more comprehensive system of reporting accidents, owing to the amalgamation of the companies, is thought to account for the increase in the number of collisions reported, but the increase in the number of derailments "seems to point to the desirability for a higher standard of maintenance in respect of permanent way and equipment." As both these classes of accidents are 30 per cent. higher than in 1921 and 1922, the better reporting may also explain the increase in derailments.

Engineers for Motor Ships.

At a meeting of the Society of Consulting Marine Engineers, which was recently held in Glasgow, the question of the examinations for certificates of competency for sea-going engineers was discussed and resolutions embodying the views of the Society with regard to engineers for motor ships, were forwarded to the Board of Trade and various shipowners' associations. The Society pleads for a broad outlook in the matter of examinations, and considers that a comprehensive training in all subjects is to be preferred to specialisation in any one system of propulsion. It considers that the competency of the sea-going engineer will be best promoted by encouraging him to give such study to the general laws of physics as will fit him to deal with any type of propelling machinery. With regard to the place of the internal-combustion engine on the examination paper, it is recommended that this subject should form part of the general examination paper in common with other subjects for the "ordinary" certificate rather than be treated as a special subject for a "motor certificate." The opinion is held that any regulations which tend in the direction of limiting the supply of motor engineers will only have the effect of favouring the competition of foreign-owned motor vessels. It is now common for marine engineers to obtain actual knowledge of oil engine machinery while it it is under construction in the engine builders' works, and this practice is approved. Motor ship owners are further requested to carry a number of junior engineers on their ships, who should take their part in watch keeping or act as assistants to the engineer in charge of the watch.

Floods and Railways.

Some idea of the extent of the damage that can be inflicted by violent storms may be gathered from the disaster that overtook some of the South-Eastern Departments of France last week, when the downfall of rain was so enormous that it partially destroyed miles of permanent way between Valence and Avignon and suspended all traffic between Paris and Marseilles. At Orange the station was flooded more than 3ft. deep. After temporary repairs had been effected a slow and intermittent service was resumed on a single line, and it is reported that it will take nearly three weeks to get the railway south of Orange back in normal working condition. The unprecedented rainfall not only proved destructive to the railways and other permanent constructions, and for the time being isolated completely whole departments, but coming after a particularly wet season, it has swollen the Rhone, Saône and other rivers, which have flooded immense areas.

A New East Coast Road.

A new road which should help materially in relieving transport congestion on the North-East Coast was opened on Saturday, the 27th ult., by the Minister of Transport. The road runs from West Hartlepool to Easington, a distance of only nine miles, but its construction, which has cost some £336,000, reduces the distance between Sunderland and West Hartlepool by five miles, while it helps in linking up a large mining area with the shipbuilding centres. The Seaton Carew to Port Clarence road, which was constructed by the Tees Commissioners during the war, already connects North Durham with Yorkshire, by way of the Middlesbrough transporter bridge, with a saving of eight miles over the old circuitous route *vid* Stockton, and it is hoped to build another road, in the future, to continue right on to Northumberland. The route proposed is from Ryhope, through Silksworth, to South Hylton, where a bridge would have to be built across the river Wear. Another bridge would be required for crossing the Tyne.

Cheap Motor Fuel.

In the absence of labour, the use of the tractor is regarded as of such vital necessity to the agricultural industry in France, that a thorough investigation is being made into the possibility of utilising home and Colonial fuels in the place of petrol, the cost of which is largely responsible for the failure of the tractor to come into general use. The Comité Central de Culture Mécanique, which is a department of the Ministry of Agriculture, is carrying out particularly exhaustive trials and tests with a view to determine whether vegetable and other oils produced in France and in the Colonies can be employed advantageously in existing types of engines. The preliminary tests with engines have just been completed, and are now to be followed by practical tests under actual working conditions, under the superviaion of engineers, on farms in different parts of the country where the tractors will be employed on all kinds of farm work. These observations will be confined at first more particularly to tractors equipped with suction gas plants, which, in practice, are already giving satisfactory results. The rapid increase in France in the number of tractors running on suction gas shows that this source of motive power has at least provided a partial solution of the problem of cheap fuel. The series of practical trials will be continued with vegetable oils and other home and Colonial fuels, and will eventually provide, it is anticipated, the most complete and scientific collection of data yet obtained concerning the different kinds of cheap fuels that may be made available for the agricultural industry.

A New C.P.R. Coasting Steamer.

On Saturday last there was launched from the Clydebank Yard of John Brown and Co., Limited, a new twin-screw steamer for the Pacific coasting services of the Canadian Pacific Railway Company. The Princess Kathleen, which was the name given to the new ship, is to take up service on the company's triangular route between Victoria, Vancouver and Seattle. Altogether this route has a length of 270 nautical miles, and is traversed every 24 hours. The present steamers have a speed of 18 knots, but the new ship and a sister vessel are designed for 21 knots, thereby giving a saving of about half an hour on the round trip. The following are the leading dimensions of the Princess Kathleen:—Length, 368ft.; breadth, 60ft.; depth to upper deck, 28ft. 9in.; with a loaded draught of 17ft. and 6000 tons gross tonnage. With her three funnels, two pole masts, and extensive deck erections, the new steamer will present a particularly handsome appearance. The hull is subdivided by eight bulkheads extending to the main deck, some of which are carried to the upper deck. In all there are five passenger decks, with sleeping accommodation for 317 first-class passengers in two and three-berth cabins. In addition, there are to be 17 special rooms on the upper and promenade decks and 22 two-berth cabins on the boat deck, all with private bathrooms. The public rooms are roomy and well designed and include a dining saloon, a social hall, with sitting and writing rooms, smoking rooms, a library, and an observation room. The vessel will be propelled by Brown-Curtis turbines coupled to the propellers through single-reduction gearing, and designed for a trial speed of 22½ knots and a service speed of 21 knots. Steam will be raised in six cylindrical boilers and two Yarrow water-tube boilers, all of which will be equipped for burning oil fuel.

Lloyd's Returns of Vessels Lost.

From Lloyd's Register of Shipping Returns of vessels totally lost, condemned, &c., which has just been issued, we learn that during the period from January 1st to March 31st of the present year a total of 105 vessels with a combined tonnage of 161,201 gross tons were, for one reason or another, lost or abandoned at sea. Great Britain and Ireland again heads the list with 22 vessels of a total gross tonnage of 38,949. With the exception of two small sailing ships of 2237 gross tons total, all the ships lost by this country were either steamers or motor ships; but we note that for these ships the losses during the period named only represent 0.24 per cent. of the ships owned and 0.19 per cent. of the tonnage owned. America comes second on the list with six steamers and motor ships of a total of 14,879 tons gross and eleven sailing ships of 17,229 tons total. Next in order is Japan with seven self-propelled vessels, representing a combined gross tonnage of 22,999 tons. The losses for the other countries with the exception of Italy, which has lost three self-propelled ships of 12,670 gross tons total, are reasonably small. Holland bears the distinction of having to record no losses over the period under review.

New Cruiser Laid Down.

With very little ceremony the keel of the cruiser Suffolk was laid at Portsmouth Dockyard on Tuesday. This vessel is one of five ships provided for in the current Navy Estimates to replace the original class of "County" cruisers which were scrapped after the war. The Cornwall is to be built at Devonport and the Kent at Chatham, while Vickers Limited and the Fairfield Shipbuilding Company, respectively, will construct the hulls and machinery of the Cumberland and Berwick. The engines of the Suffolk are to be manufactured by the Parsons Marine Steam Turbine Company; those of the Cornwall by R. and W. Hawthorn, Leslie and Co.; and those of the Kent by W. Beardmore and Co. It has been officially stated that the ships will conform to the Washington Treaty, in that they will not exceed 10,000 tons "standard" displacement or carry guns of more than 8in. calibre. It is anticipated, however, that the design will provide for a high speed, an extensive radius of action, and good sea-keeping qualities, as the ships are intended to serve as guardians of trade on the ocean routes, a duty for which few of our present cruisers are adapted. The four other vessels of the class will probably be put in hand at an early date. The Suffolk is the first cruiser to be laid down in this country since the war, for the Adventure, recently launched at Devonport, is officially designated a cruiser-minelayer. The Admiralty has announced that forty-seven additional cruisers must be built in the next ten years if naval requirements in this type are to be met.

The Scuttled Warships at Scapa Flow.

When the Germans scuttled their ships at Scapa Flow in 1919 they did their work methodically and took all possible steps to place difficulties in the way of anyone who might subsequently attempt to raise the vessels. The Scapa Flow Salvage Company now engaged on the work reports that in four of the destroyers it has been found that the condenser doors had been taken off, all auxiliary valves, the sea connections in the boiler-rooms, and the magazine valves opened, the hatches and water-tight doors raised, even the ports and lavatory connections left unfastened. With characteristic thoroughness the Germans even removed all plates indicating the positions of the various valves which they had opened. The salvors, we understand, have experienced some difficulty in discovering the positions of the valves, but are now steadily succeeding with their arduous task.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. XXIV.*

ELECTRICAL ENGINEERING EXHIBITS.

THE METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED.

ONE of the most important electric traction exhibits at the Exhibition is a 3000-volt direct-current electric locomotive, which has been built at the Trafford Park works of the Metropolitan-Vickers Electrical Company, Limited, for the Glencoe-Pietermaritzburg section of the South African Railways. The portion of the system which is being electrified will have to deal mainly with heavy mineral traffic. It traverses very hilly country and is 171 miles long. It reaches an altitude of 5000ft. above the sea level and runs down to a 2200ft. level at Pietermaritzburg, and in the latter part of the line there is a section which drops 1350ft. in a distance of 14½ miles. Current is to be supplied to the trains at a pressure of 3000 volts, the return circuit being through the track. Sub-stations along the line will be supplied with three-phase 50-cycle current at a pressure of 88,000 volts from an overhead transmission system.

Seventy-eight locomotives of the type shown by Fig. 454 and on page 382 are being built for the railway by the Metropolitan-Vickers Electrical Company. In view of the limitations of the track, such as the gauge, a minimum radius curve of 300ft., the load per axle, and the heavy trains which have to be dealt with, a single locomotive unit is unsuitable, and three engines are therefore coupled together and are driven from a single driver's cab. Under normal working conditions three locomotives will haul a goods train weighing 1430 tons to Pietermaritzburg, and on the return journey a train weighing 700 short tons. When speed variation is necessary on down gradients regeneration will be adopted. The leading dimensions of the locomotives are as follows :—

Weight in working order	66 tons 12 cwt.
Weight of mechanical portion	39 tons 8 cwt.
Weight of electrical portion	27 tons 4 cwt.
Type of locomotive	A.A + A.A.
Gauge	3ft. 6in.
Motor equipment	Four 300 H.P. motors
Total motor rating	1200 H.P. one hour rating
Tractive effort, full field	21,200 lb. one hour rating
Tractive effort, maximum	40,000 lb.
Tractive effort, full field	16,400 lb. continuous
Speed, full field	21.5 m.p.h. one hour
Speed, full field	23 m.p.h. continuous
Maximum safe speed	45 m.p.h.
Traction system	3000 volts D.C.
Brakes	Compressed air operated
Overall length	43ft. 8in.
Overall height of body (pantograph down)	12ft. 11.3in.
Overall width of body	9ft. 2.25in.
Diameter of driving wheel	4ft.
Fixed wheel base	9ft. 3in.
Total wheel base	30ft. 11in.
Distance between bogie centres	21ft. 8in.
Weight per driving axle	16 tons 13 cwt.

The body of the locomotive, which contains the electrical equipment and auxiliary gear, is supported on two four-wheel bogies which are coupled together by an articulating joint, which allows of free movement between the trucks. Buffing and draw gear of the central type is mounted directly on the bogie trucks. The bogie centre pivots are composed of three castings. The top is made of steel and is rigidly bolted to the underframes and has a spherical seating which rests on a phosphor-bronze rubbing plate which is held by a steel casting bolted to the bogie centre stay plates. On one bogie the rubbing plate is held firmly in the bogie casting whilst on the others it is free to move longitudinally, an arrangement which compensates for the varying positions of the bogies on curves.

The body is relieved of all draw and buffing shocks, for they are transmitted through the bogie frames and the articulating joint. Spring-loaded side and end bearers steady the body and the bogies. The bogie trucks are constructed of frame plate and have top and bottom stay plates at the ends and at the centre. Besides supporting the bogies, the transom centre casting also carries the motor nose suspension brackets. The bearing springs are of the laminated type and there are adjustable springs above each axle-box. Compensation is provided for by beams pivoted on knife edges which are attached to the centres of the bogie frame plates. The body of the locomotive is divided into five compartments and there is a driver's cab at each end containing all the control gear, meters, gauges, brake van valves, &c., for the control of the locomotive. A view of one of the driver's cabs is given in Fig. 455, and a view of the corridor at the side of the locomotive is given in Fig. 456. The illustration Fig. 457 shows the high-tension chamber, which contains all the high-voltage control gear.

Access to this chamber is gained by a sliding door which is mechanically and electrically interlocked so that it cannot be opened when the pantograph is in contact with the overhead line. The spaces between the high-tension compartment and the cabs at each end of the locomotives are occupied by the auxiliary gear, which includes two motor generators—see Figs. 458 and 459—each coupled to a blower. There is also a compressor, exhauster, air reservoirs for the brakes, and low-tension control gear. The sections of the roof above these compartments and above the high-tension chamber are easily removed, so that the heavy machinery and control gear can easily be lifted out.

FIG. 454—TWO 3000-VOLT DIRECT-CURRENT LOCOMOTIVES—METROPOLITAN-VICKERS

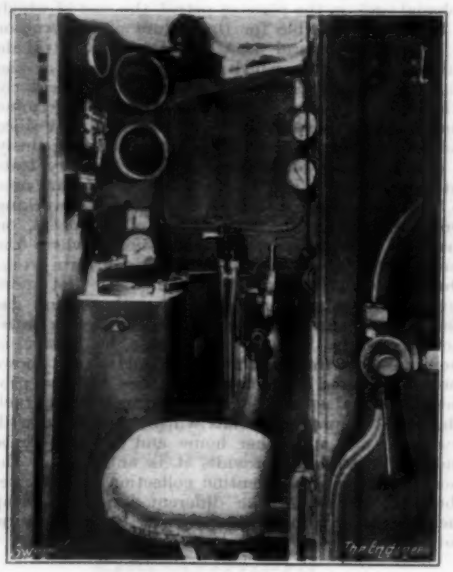


FIG. 455—DRIVING CAB

Vacuum brakes are used on all the rolling stock, but the locomotive brakes are operated with compressed air, as this system has been found to be more suitable under the prevailing conditions. Application of the vacuum brakes by means of a vacuum-operated valve produces a proportional braking effect on the locomotive.

For shunting purposes the driver is provided with a compressed air valve, which only applies the locomotive brakes. An air connection in the main reservoir circuit between the locomotives can supply air to another locomotive in the event of the air compressor for that locomotive failing. The sand valves are electrically operated, and their control wires are included in the bundle of train line wires, so that all the locomotives which are coupled in multiple sand simultaneously.

The four main motors—one of which is shown in Fig. 460—are series wound, and two are permanently connected in series, so that there are 1500 volts on each commutator. They have been designed to give the maximum output that can be obtained in the limited space available, namely, 300 horse-power on the one-hour test basis when working with a full field. With the gear ratio of 17/95 and with 48in. diameter wheels, this corresponds to a speed of 21.5 miles per hour. The magnet frames are cast in one piece and are octagonal in shape. The motors are suspended by means of the usual axle bearings, and from a nose on the other side of the motor which is supported on rubber springs held in the suspension bracket on the bogie transom. The motors are four-pole machines, and are fitted with interpoles. A tapping is provided on the main field to give a reduction in the excitation,

* No. XXIII. appeared September 26th, 1924.

so as to enable the machines to run with a weak field. Inspection covers at the commutator end enable the brushes to be inspected. Forced ventilation is provided. Air is conveyed to the motors through a flexible air duct leading from the blowers; it flows in parallel paths through the machines, and leaves by way of openings at the pinion end.

Each locomotive is fitted with two pneumatically-operated pantographs, and springs ensure that a uniform pressure is maintained with varying heights of the trolley wire. The whole of the pantograph framework is carried on four insulators, which are supported on the roof by heavy brackets. Air is fed to the pantograph cylinders through an electrically-operated valve, controlled by a two-way valve in the driver's cab. The pantograph control wires pass through the train with the other control wires, so that the driver has complete control over all the pantographs from the cab. Each pantograph is capable of collecting the current for all the motors, and it is, therefore, only necessary to have one pantograph in use at a time.

Current is led through the main equipment by way of the main isolating switch, which is situated in the high-tension compartment. The door of this compartment is interlocked with the switch, and the pantograph circuit, so that it is impossible for anyone to enter the compartment when the equipment is alive. The isolating switch is connected through a trolley overload trip to the control equipment, the line and resistance switches being of the type shown in Figs. 461 and 462. These switches, which are pneumatically operated, have a contact pressure under normal working conditions of 140 lb., and to insure a high speed of break, the piston closes against a heavy spring. All the parts of the switch which carry the main current are insulated for a working pressure of 3000 volts to earth. The switches are arranged in groups along the centre line of the locomotive, and in the centre of the compartment the cam operated switch groups—shown in Fig. 463—are placed. These switches are operated by a double-ended piston carrying a rack, which engages with a pinion fixed on the end of the cam shaft. The cam-operated switches are used for the motors, combination for forward and reverse running, regenerating, and for the weak field connections. In every possible case the switch and resistance connections are composed of bare copper rod or strip. The resistance frames are arranged above the switches, and they are of the cast grid three-point suspension type. The grids are carried by three insulated bars, which are held by insulators in the end frames, and as a further precaution the frames are insulated from the supporting beams. The control wires are carried in a trough which runs behind the switches.

The high-tension compartment also contains contactors for starting up the motor generator sets. The groups of auxiliary fuses are shown in Fig. 464. These fuses are of the expulsion type, and are graded in steps with suitable resistances. There are also motor overload and over voltage relays, which operate an auxiliary relay connected in the control circuit of the resistance switches, stabilising resistances and switches, and all other high voltage gear.

The master controllers in the driver's cabs have three drums mounted on a central spindle. The drums are used to alter the connections so as to give the different motor combinations. A complete interlocking system is employed. As the currents used for energising the magnet valves are extremely small and the control circuits work at a pressure of 100 volts, no blow-out coils are required.

All wires from the master controller are connected to a terminal board at the back of each cab, and the boards are connected together by two train line wire bundles to four jumper receptacles on the under

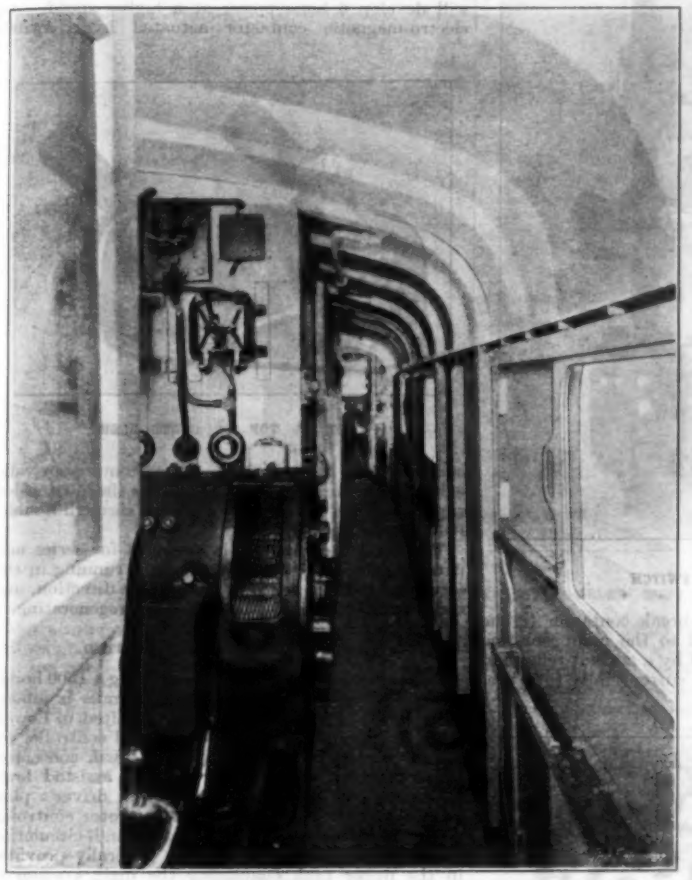


FIG. 456—CORRIDOR AT SIDE OF LOCOMOTIVE

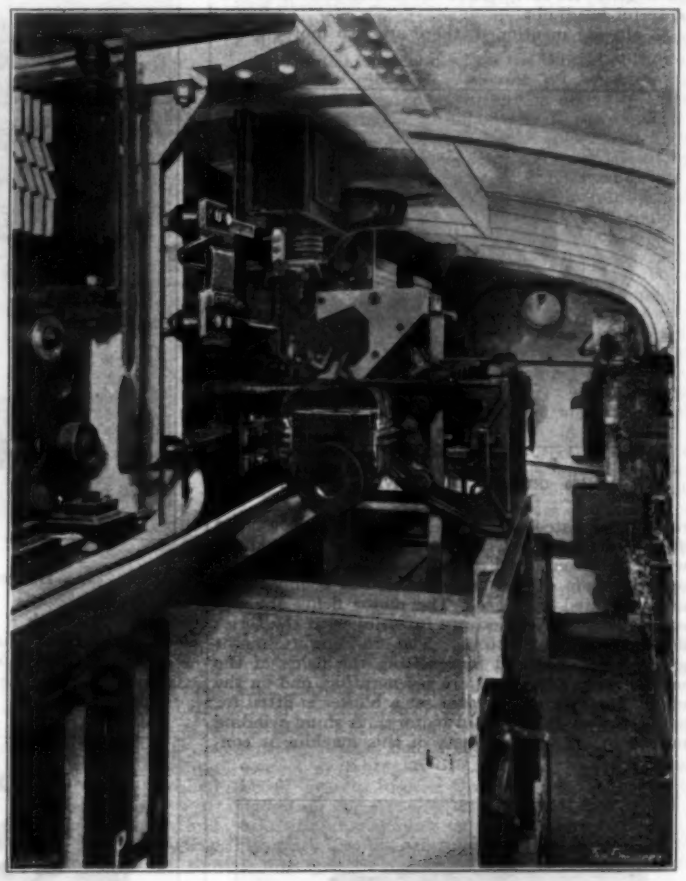
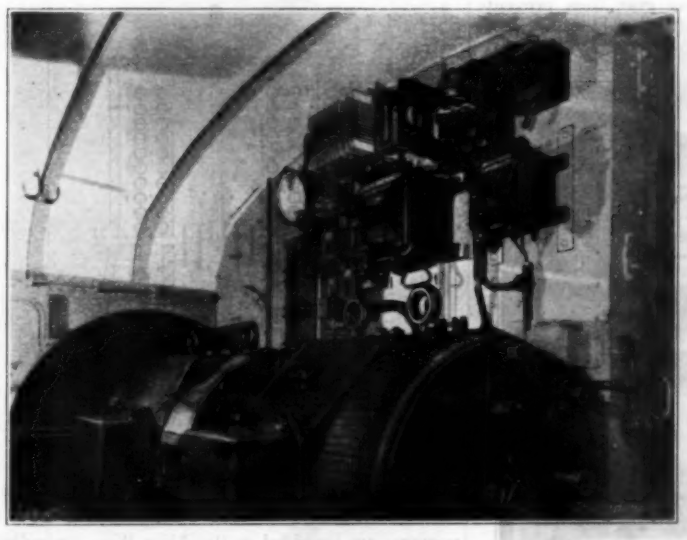
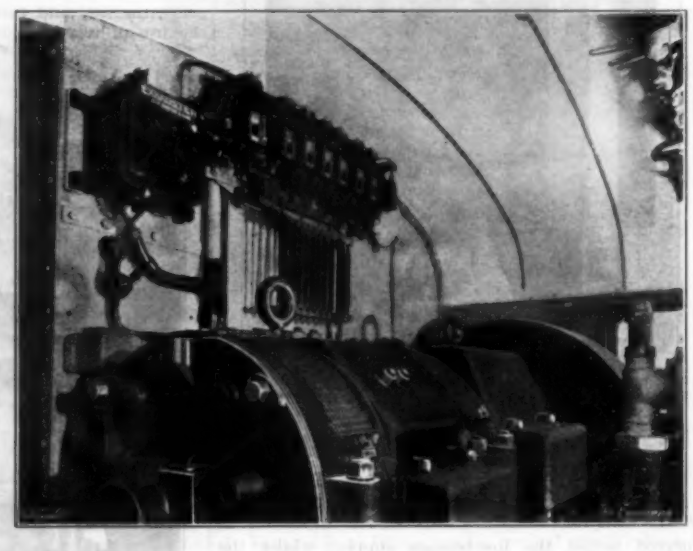


FIG. 457—THE HIGH-TENSION CHAMBER





FIGS. 458 AND 459—MOTOR GENERATORS

frame at the ends of the locomotive. The control equipment can be completely isolated by a multi-point cut-out switch which is connected between the main terminal boards and the control equipment. Defective motors are cut out by switches connected in the control circuit. Lighting current is provided by the 100-volt circuit which is fed by the 16-kilowatt generator working in parallel with a 100-volt battery which is carried on the outside of the locomotive in two boxes suspended from the underframe between the bogies. At each end of the locomotive there is a powerful headlight.

As already mentioned, there are two motor gene-

FIG. 460—ONE OF THE DRIVING MOTORS

rators, one rated at 16 kilowatts and the other at 28 kilowatts. In each case the motor has two windings which are connected to separate commutators at opposite ends of the armature. The commutators are connected in series. The motor fields are also connected in series and are in series with the series fields of the generators. The 28-kilowatt motor generator set is used for exciting the fields of the main motors when they are regenerating, and on the end of this motor generator set a blower is fitted for supplying air to the main motors. A shunt winding on the motor field magnets of this machine is con-

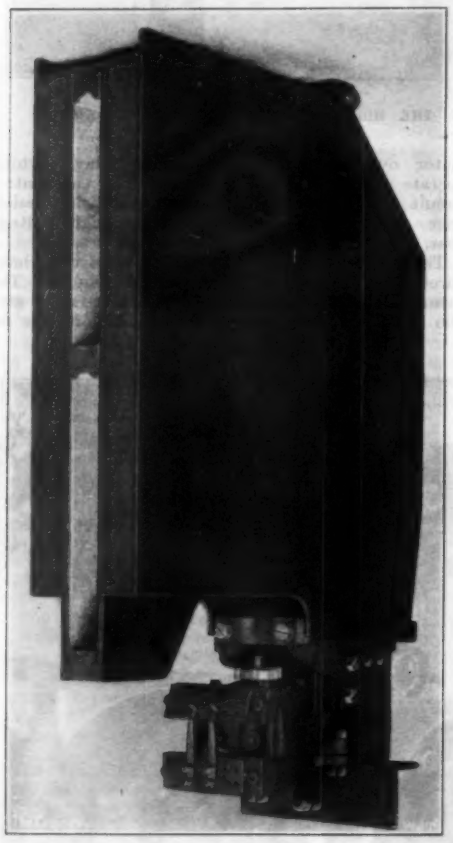


FIG. 461—H.T. SWITCH

nected across the low-tension supply, whilst the generator has a shunt winding in series with a regulating resistance, which is cut out in steps by electro-magnetic contactors actuated by the regeneration drum on the master controller, the winding being connected directly across the low-tension generator. A view of the top of one of the controllers is given in Fig. 465.

Current supplied by the 16-kilowatt machine is used for the control circuits, lights, exhauster, compressor, cab heaters, for exciting the larger motor generator and for charging the battery. In the case of this machine the motor and generator frames are separate, but they stand on the same bed-plate. A fan connected to the armature shaft supplies two of the motors with forced ventilation. The motor generators are connected in series with starting

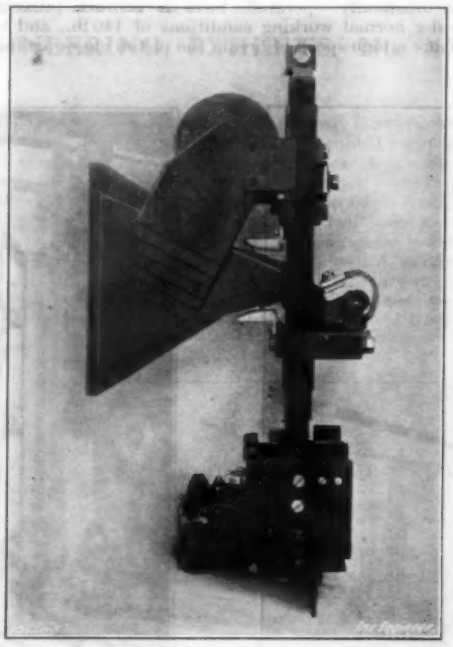


FIG. 462—H.T. SWITCH

resistances through a double-break contactor to the 3000-volt auxiliary fuses and to the main isolating switch. A contactor operated by a current relay and set to close when the motor current falls to a pre-

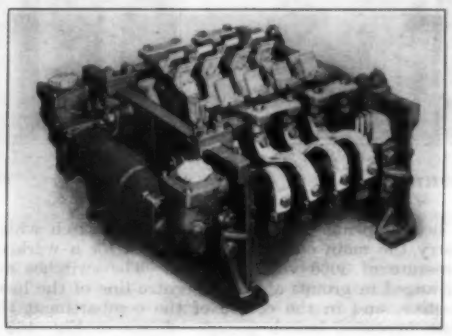


FIG. 463—CAM-OPERATED SWITCH

determined value, short circuits the starting resistances. It is possible to cut out the large motor generator set, and interlocking gear then prevents the use of regeneration. Normally, however, both

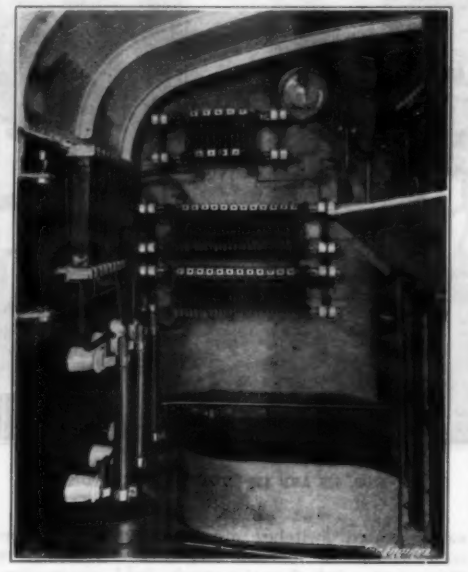


FIG. 464—AUXILIARY FUSES

sets are always running. The compressor is a horizontal two-cylinder machine, and is driven through gearing by an 8 horse-power series-wound motor which is switched into circuit through a starting resistance by a contactor operated by a time lag relay.

When working locomotives in multiple simultaneous control of all the contactors is obtained by a synchronising wire connecting up the compressor governors which are connected in the control circuit. The compressors supply air to the brakes, sanders, horns, control gear, and pantographs. The exhauster is a rotary drum type machine and is directly coupled to a series motor with a tapped field. The motor is rated at 4 horse-power at 1400 revolutions, but it will develop 6 horse-power at a higher speed. An electro-magnetic contactor actuated by a switch

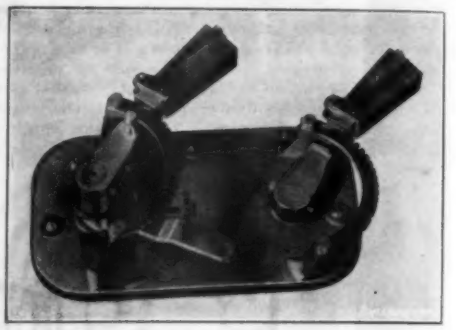


FIG. 465—TOP OF CONTROLLER

controls the tapped field. The compressor and exhauster motors are connected across the low-tension supply and are switched into circuit through double-pole switch fuses.

The control equipment is arranged for series and parallel operation when the engine is running in the forward direction, series in the reverse direction, and series parallel when the machines are regenerating.

Allen West and Co., Limited.

A complete equipment for controlling a 1500 horse-power 3300-volt alternating-current winder is among the exhibits of Allen West and Co., Limited, of Lewes-road, Brighton. It consists of a liquid controller for the rotor circuit, a high-tension air break contactor, stator reverser, and a compressed air assisted lever operating gear mounted on a typical driver's platform. An interesting feature of the rotor controller is the patented system for cooling and circulating the electroyte. Cooling pipes are generally provided in the upper tank containing the main portion of the liquid resistance, but no arrangements, the makers contend, have hitherto been provided to circulate this cooled liquid between the electrodes in the pot below, where the actual heating takes place. The cooled liquid has to flow down the same pot in which the hot liquid is rising from the electrodes, with the result that no proper circulation occurs. Local heating and the formation and accumulation of steam and gases have hitherto taken place in the pot between the two electrodes, thus interfering in many cases with the smooth regulation and the efficiency of the control.

To overcome this disadvantage, channels or

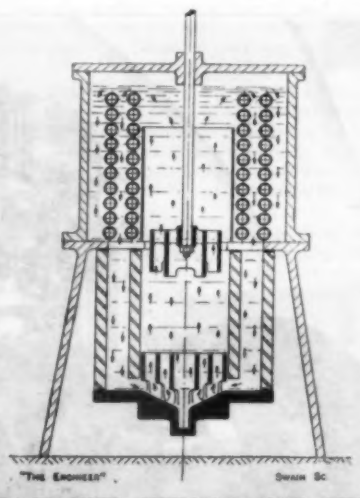


FIG. 466—LIQUID CONTROLLER—ALLEN WEST

passages are provided in the Allen West controllers, at the sides of the chambers, and also passages through the stationary and moving electrodes—as shown in Fig. 466. Baffle plates isolate the column of liquid resistance vertically above the inner chamber, through which the moving electrodes rise and fall, the height of these baffle plates being such that ample space is left between their top edges and the surface of the liquid resistance. In the space between the baffle plates and the outside wall of the tank there are pipes through which the cooling water can be circulated. Circulation is induced by the heated electrolyte rising between the electrodes, where the

heating takes place, through and round the electrodes, and this heated column of electrolyte rises until it reaches the top of the baffle plates, when it is drawn down the sides by the downward-flowing liquid cooled by the water pipes in the space outside the baffles. The only route for the cooled liquid is down the channels communicating with the passages in the stationary electrodes, whence it can only flow through the lower electrode and up again through the space between the electrodes. This circulation continues freely in any position of the moving electrodes, and is maintained when the electrodes are in the short-circuiting position, thus effectively preventing the formation or accumulation of hot gases between the two electrodes and making the use of auxiliary metallic short-circuiting contacts unnecessary. At the same time it makes the speed control smooth and efficient up to top speed.

The controller is fitted with a governor device, which prevents the motor being accelerated too rapidly. The contactor stator reverser has six single-break switches with massive contacts of the roll and wipe pattern, and suitably shaped arcing contacts. Each switch unit is also provided with a very powerful magnetic blow-out and large arc shields. The equipment is operated by a single lever, which is mounted on the driver's platform and allows of quick reversal for decking, &c. An auxiliary compressed air engine is fitted for assisting the manipulation of the lever, and enables a large controller to be operated with a small effort. For dealing with smaller motors of, say, 600 horse-power, at 3300 volts, another type of reverser is shown. It is mechanically operated directly from the lever gear, and it has a definite quick make-and-break action, which is independent of the operator. The speed of breaking is so rapid that the arc is immediately quenched and very little carbonisation of the oil occurs. Self-aligning blade and jaw type contacts are used, and they can readily be removed. Lowering gear is also provided for lowering the tank. Switches of this type can also be supplied with flame-proof cases to enable them to be installed in fiery mines.

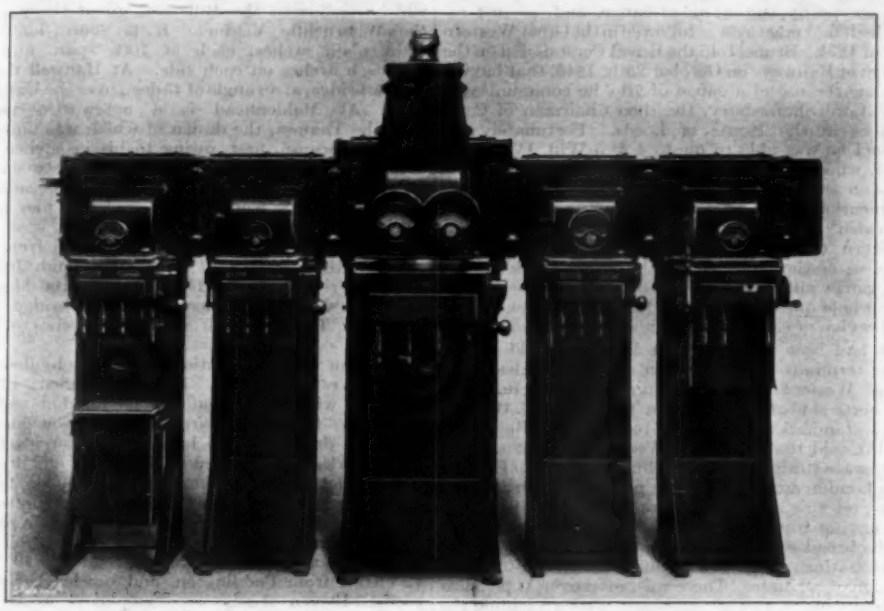


FIG. 467—GROUP OF STARTERS—ALLEN WEST

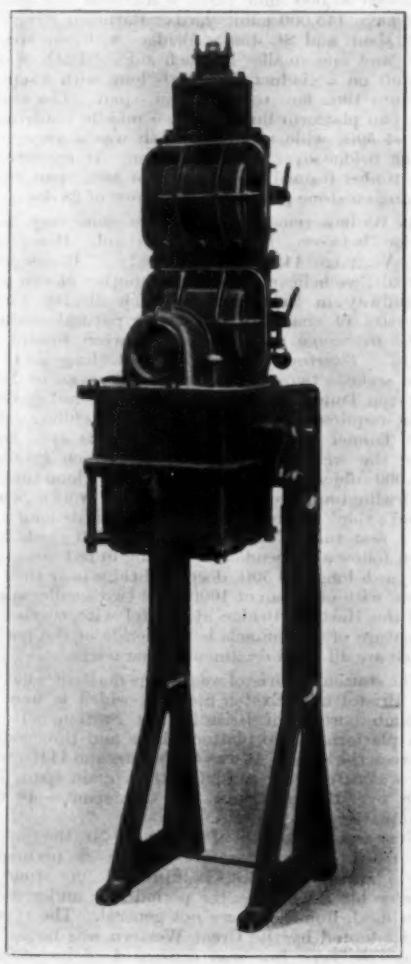


FIG. 468—FLAME-PROOF CIRCUIT BREAKER—ALLEN WEST

A range of oil-immersed ironclad star-delta change-over and auto-transformer starters and circuit breakers is on view. These starters are assembled together so as to form a switchboard—as shown in Fig. 467—a switchboard formed in this way being complete with circuit breakers, bus-bar chambers, isolating switches, ammeter and cable boxes and glands. A simple safety interlocking device prevents the oil tank or switch cover being removed while the isolating switch is in the "on" position, and it also prevents the isolating switch being closed if the switch cover or tank is removed from its normal position, thus providing the same degree of safety as that obtained with draw-out switchgear.

Patented self-aligning contacts of the drum controller pattern break the circuit under a large head of oil. The overload trips act directly on the trip mechanism, with the result that no relay contacts are needed. Moreover, as a free handle is fitted, the switch cannot be held in the closed position on overloads. As the contacts operating mechanism, &c., are standardised for all the different types of starters of the same capacity, the stock of spares can be reduced to a minimum. The switch on the extreme right of Fig. 467 is one of the firm's "S R" combined stator and rotor panels, designed for starting up slip-ring induction motors. It is of the totally enclosed ironclad oil-immersed type. The stator circuit is controlled by a three-pole contactor circuit breaker, and a face plate starter is used for the control of the rotor circuit. Overload and no-volt protection is provided, the contactor operating coil acting as the no-volt release. The rotation of a hand wheel first of all closes the stator contactor, whilst subsequent revolutions cut out the resistance in the rotor circuit by a quick step-by-step movement. The starter acts as a loose handle circuit breaker, and an interlock prevents the stator circuit being made unless all the resistance is inserted in the rotor circuit.

The oil-immersed flame-proof circuit breaker, shown in Fig. 468, is another exhibit on Allen West's stand. All the parts are enclosed in a flame-proof case, with machined flanges 2in. wide. The switch has been tested at the Sheffield University, and a certificate from that University is exhibited. Another notable exhibit is a complete control equipment for a four-motor direct-current crane. It consists of a contactor panel and a drum type master controller for the hoist motor, air break drum controllers for the other motions, a crane protective panel, and brake solenoids. The contactors on the contactor panel are very compact, and are assembled close together. The magnet frame gives a powerful pull, but it is of light construction, and the blow oil enables it to rupture the arc when breaking ten times the normal current at a pressure of 460 volts.

The Allen West patented compensated series lock-outs are fitted on the accelerating contactors. The drum controllers are of the makers' well-known standard type, fitted with spring return handles. The crane protective panel, which is of the contactor and relay type, consists of a double pole contactor circuit breaker, with an overload time lag relay in the positive lead of each motor, and an overload relay without a time lag in the negative lead. The two control switches are double-pole quick make-and-break switch fuses. One controls the contactor operating coil circuits and the pilot lamp, and the other the hand lamp or lighting circuits. All the auxiliary circuits are protected by fuses. The contactor operating coil circuit is connected in series with the interlocking rings on the drum controller, so that if the circuit breaker is opened it cannot be re-closed until all the contactors are in the "off" position.

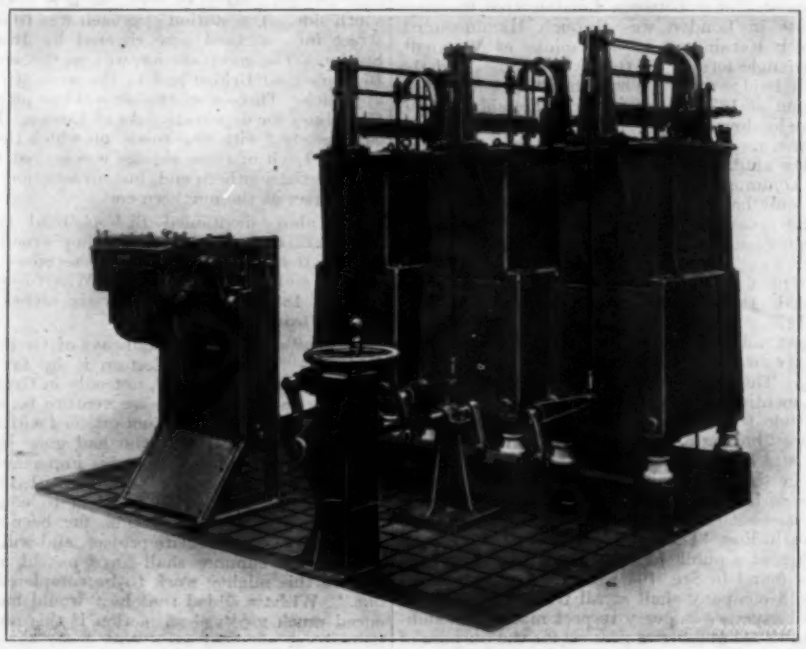


FIG. 469—THREE-PHASE DIMMER—ALLEN WEST

A 55in. circular lifting magnet shown on the stand is capable of lifting, under normal conditions, a load of over 3 tons of shafting, round bars, rails or billets, and will lift 1200 lb. of light scrap or turnings. Magnets of this type are made with diameters of 24in., 36in., 48in., 55in. and 65in., and the firm also manufactures a rectangular-shaped magnet, which is fitted with mobile fingers. This type of magnet is more suitable than the circular type for handling straight lengths of rails, &c. A special feature of the firm's magnet equipments is a patented potentiometer scheme of control which prevents the voltage rising to a higher value than the line pressure, when the magnet is de-energised, and consequently

there is little risk of breaking down the insulation.

An Allen West ironclad distribution switchboard is installed in No. 1 sub-station of the Exhibition, adjoining the main power station in Bay D of the Palace of Engineering, and it controls the distribution mains running to different parts of the Exhibition. The board is composed of nineteen oil-break ironclad circuit breaker units. There are five incoming 750-ampère units and seven 350-ampère units on each side, and these fourteen units control the distribution circuits.

The three-phase dimmer control equipment—shown in Fig. 469—is used in connection with the flood lighting scheme in various parts of the Exhibition, and it is installed in the dimmer room near the Stephenson Gate entrance at the south-west corner of the Palace of Engineering. Three complete sets are in use. Each set comprises an ironclad oil-immersed circuit breaker, with no-load and overload protection. Three separate liquid resistances, one in each phase, are mechanically coupled together, and are operated by a single hand wheel through the gear to be seen in the foreground. These liquid resistances are built up on the same principle as the Allen West liquid controllers, the cooling and circulating system corresponding with that described. Each phase deals with a maximum current of 750 ampères continuously.

One Hundred Years of British Railways.

No. XIV.*

PART II.—THE FIRST HALF CENTURY.

THE GREAT WESTERN RAILWAY.

The Great Western Railway has one happy singularity—it has never changed its name. When, in August, 1833, the first prospectus was issued the proposed new line was called the Great Western; to-day, despite the changes made by the Railways Act, 1921—when all the British systems except those jointly owned, some electrically operated lines and the light railways lost their identity—it bears the same name.

The earliest of the schemes was for a railway between London and Reading and another between Bath and Bristol, the intervening stage being taken by canal. The success of the Liverpool and Manchester Railway led, however, to the abandonment of the idea of utilising the canals—which by then had considerably deteriorated—and a railway throughout was proposed. The survey for it was entrusted on March 7th, 1833, to Isambard Kingdom Brunel by a committee of Bristol merchants. On August 19th of the same year the Bristol committee and one which had been formed in London met together and issued a prospectus for the new railway, which, however, would extend only between London and Reading. The route in London was through Hammersmith and South Kensington to a terminus at Vauxhall, in the triangle formed by the river Thames and the Vauxhall Bridge-road. When the Bill came before the session of 1834 it met with considerable opposition from landowners whose property was threatened. There was, moreover, with more reason, opposition of another kind. It came from those who wished for railway communication beyond Reading, who called the Bill only half a measure, and who were doubtful as to the promoters going further than that town. The opposition was successful and the Bill was rejected.

In the next session a Bill for a line to Bristol was introduced. It was successful, and became 5 & 6 Will., c. 107, 1835. It gave powers for the construction of the longest railway, 118¼ miles, up to then authorised. The Act contained some clauses which to-day are amusing. They were seriously intended at the time and are mentioned here only to show how changed is the attitude towards railways. Sec. 100 prohibited the railway having a branch within 3 miles of Eton College, and Sec. 101 prohibited the building of any station in that area. The latter section did not, however, forbid the trains stopping within the area, and for passengers to and from Slough they stopped on the main line. There was no station, and tickets were taken at a public-house. The crowning restriction was found in Sec. 103 which ran as follows:—"The said company shall at all times at their own costs and expenses in every respect maintain a sufficient additional number of persons for the purpose of preventing or of restricting access to the said railway by the scholars of Eton College aforesaid on the foundation or otherwise on such part of the railway as is hereinbefore directed to be fenced in and that the said persons shall be appointed by the directors of the said company subject always to the approval of the Provost and Headmaster or either of them for the time being of Eton College aforesaid and shall be of such number as the said Provost and Headmaster or either of them shall think request and determine and shall in every respect be under the orders control and direction of the said Provost and Headmaster or either of them and shall be liable to be dismissed upon the representation of the said Provost and Headmaster or either of them."

* No. XIII. appeared September 26th.

What, at this time, appears a leading feature of the Act is that, whilst the Bill of 1834 provided that the railway would be of the 4ft. 8½in. gauge, no mention was made of the intended gauge in the Act. This omission was not accidental, but deliberate. Prior to 1834 it had been taken for granted that the width between the rails would be 4ft. 8in. or 4ft. 8½in., or the gauge had been left to the pleasure of the promoters. In the year just named it became the practice to specify the intended gauge, and, as just remarked, that practice was followed in the Great Western Bill of 1834. Brunel told the Royal Commission on the Gauge of Railways on October 25th, 1845, that having in view the use of a gauge of 7ft., he communicated with Lord Shaftesbury, the then Chairman of Committees in the House of Lords. Fortunately for Brunel he was able to quote 4 & 5 Will. IV., c. 88, 1834, which gave powers for the construction of the London and Southampton Railway. In it there was no mention of the intended gauge, and this omission provided a precedent which enabled the Great Western to use any gauge it pleased. The consequences of the adoption by the Great Western of a 7ft. gauge will be the subject of a subsequent article. The whole question needs to be dealt with at length, and reviewed calmly and without prejudice.

It had been intended that Euston should be the joint terminus of the London and Birmingham and Great Western railways, a junction being made on the north side of Kensal Green Tunnel. J. C. Bourne, in his standard work, "The Great Western Railway" (1846), said that the Great Western was not allowed a separate station in London, but had to go to Euston. The London and Birmingham people, however, began to regret this arrangement, and made the necessity for having to provide for two gauges—the adoption of the broad gauge was subsequent to the plans for a joint station—a good and sufficient cause for their change of attitude. There was, moreover, a physical difficulty in the way of the Great Western joining the London and Birmingham. This was the Birmingham, Bristol and Thames Junction Railway—later the West London—sanctioned in 1836. At the half-yearly meeting of the Great Western Company at Bristol on August 25th, 1836, the chairman said that this unexpected objection on the part of the London and Birmingham had been counteracted. The general consent of the owners and occupiers had been obtained for an extension line into Paddington. The length from Acton to Paddington would be greater, but, after deducting the line to Kensal Green, which would not be made, their would be only 2¼ miles of additional railway, and the company would enjoy its independent approach to the Metropolis instead of using 5 miles in common with the London and Birmingham. This extension was sanctioned by 6 & 7 Will. IV., c. 38, 1836. The original Paddington Station was on the site of the present goods yard, and lay to the west of Paddington Canal. The station was then on the north side of what is now Bishop's-road Bridge, instead of being, as it is to-day, on the south side. The station approach was from London-street into a yard now covered by Bishop's-road Station. The goods station was on the south side of Bishop's-road Bridge and to the west of the station approach. There were two arrival line platforms and three lines for departure. As at Euston, there was a carriage shed with four roads, on which the carriages stood. Each of these sidings was served by a turntable at the southern end, but, in addition, there was a traverser at the northern end.

The above-mentioned Bishop's-road Bridge was built to carry an extension of Bishop's-road from near Spring-street — now Eastbourne-terrace — over the railway and the canal to North Wharf-road. It was built in 1838 and had twenty-six arches, of spans varying from 17ft. to 20ft.

Wishaw said in "The Railways of Great Britain" (1840):—"The Great Western is by far the most gigantic work of the kind, not only in Great Britain, not only in Europe, but, we venture to say, in the whole world. Mr. Brunel, not satisfied with the beaten track pursued by those who had gone before him, determined on carrying out this important work on entirely new principles; and, notwithstanding the numerous adversaries he has had to contend with from every quarter, has thus far been eminently successful in his favourite project, and will no doubt, ere another summer shall have passed away, pronounce this mighty work to be completed throughout." Wishaw added that he "would have experienced much greater satisfaction if this object could have been attained at a cost little exceeding the parliamentary estimate."

Brunel showed wonderful skill in the way in which he acquired a remarkably level road for his line. The summit of the line was at Swindon, 76 miles from Paddington. In that distance the line rose 252ft. In the next 42 miles the line fell 274½ft., and at Bristol it was 22¼ft. below the level of the line at Paddington. This variation was mainly effected by two inclined planes, one at Wootton Bassett, between Swindon and Chippenham, and the other at Box, between Chippenham and Bath. The gradients on these inclines were only 1 in 106, and it may be remarked that Brunel told the Committee of the House of Lords which was considering the Bill of 1835 that the inclination was "considerably less than the descent from the houses at the corner of Parliament-street to the Parliament Houses; it is half as steep as the Burlington Arcade and exactly the same as the Lowther Arcade, and, therefore, as regards any appearance of steep descent, there can be none."

There are several bridges of note on the line. At 7 miles is that over the Brent at Hanwell, which, as a mark of respect for Lord Wharncliffe who had been the chairman of the House of Lords Committee which considered the Bill, was given the name of the Wharncliffe Viaduct. It is 896ft. long with eight main arches, each of 70ft. span, and five approach arches on each side. At Hanwell there is a skew bridge, at an angle of 45 deg., over the Uxbridge-road. At Maidenhead is a noteworthy viaduct over the Thames, the design of which was unusually difficult because, first, owing to his insistence upon a level road, Brunel had little space between high water and the railway; and, secondly, because the river authorities would allow only one pier in the river. The two arches are each of 128ft. span, with a rise of only 24ft., and are approached from each side by three arches of 28ft. span, and, furthest from the river, one of 21ft. span. At Basildon and again at Moulsford, there are skew bridges over the river Thames, each with four arches of 62ft. span.

Swindon was the junction for the Cheltenham and Great Western Union. It corresponded, in two respects, with Wolverton on the London and Birmingham—it was a refreshment station and the repairing depôt for the locomotives, carriages, &c. These works were founded in 1842. Beyond Swindon is the Wootton Bassett incline, 1 mile 30 chains long and rising 1 in 106 towards London. At Chippenham there is a bridge of three arches over the main road.

Box Tunnel is also on a gradient of 1 in 106, rising towards London. The eastern end is 99 miles 12 chains from Paddington, and the length is 3123 yards. Eleven shafts were employed in its construction, of which six remain for ventilation. In its excavation 247,000 cubic yards of material were removed, of which 174,000 cubic yards were composed of freestone and marl and the remainder of freestone. Considerable trouble with water was experienced and was not overcome until additional pumping machinery had been provided. From the eastern approach to the tunnel 1,533,000 cubic yards of material were removed. West of Box Tunnel is the Middle Hill Tunnel, 210 yards long.

Approaching Bath are Bathampton cutting which produced 87,000 cubic yards of material and another that gave 145,000 cubic yards; Bathford Bridge, of 54ft. span, and St. James Bridge, with one span of 88ft. and one smaller on each side. Bath Station is built on a viaduct 500 yards long with 65 arches of from 19ft. 6in. to 20ft. 5½in. span. The station had two platform lines and two middle roads under a roof 50ft. wide. Beyond Bath was a very interesting bridge over the river Avon. It consisted of two timber-framed arches, each of 89ft. span on the square, on stone piers, and on a skew of 28 deg.

As Wishaw remarked, there are some very heavy works between Bath and Bristol. Herapath—Vol. V., page 442—also observed: "It would be difficult, we believe, to instance another eleven miles of railway in the kingdom which display such a diversity of character or greater natural obstacles to be overcome than the line between Bristol and Bath." Twerton Viaduct is 245ft. long and has nine arches—two of 24ft. span and seven of 15ft.; Twerton Tunnel is 256 yards long; Saltford embankment required 583,000 cubic yards of filling; Saltford Tunnel is 106 yards long, and is approached from the west through a cutting which furnished 525,000 cubic yards of material; in the "long tunnel" at Brislington, 50 chains long, old coal workings were found; the "second tunnel" is 154 yards long; and the "first tunnel"—now removed—330 yards long. Then follow a perpendicular cutting in red sandstone, 170 yards long and 50ft. deep; a bridge over the river Avon, with one span of 100ft. and two smaller spans; and the Harbour Bridge at Bristol with two arches. A feature of the tunnels is the design of the portals, which are all of an ornamental character.

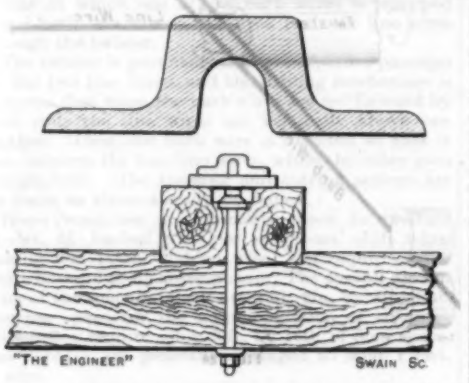
The station at Bristol was to the north of what was the Bristol and Exeter Station—which is now the through portion of Bristol Joint Station. It had two platforms, two platform lines and three sidings between the latter. It was 408ft. long and 114ft. wide, and was carried by a roof with a main span, 74ft. wide, over the rails and two side spans—one over each platform.

Next to the adoption of a gauge of 7ft. the remarkable feature of the Great Western was its permanent way. Transverse sleepers, instead of stone or wooden blocks, had by the period now under review been used, but they were not general. The type of road adopted by the Great Western was not of the transverse type but was composed of longitudinal timbers. In passing it may be remarked that the present sleeper yard at Hayes is contemporary with the commencement of the Great Western Railway. The timbers came thither by canal and were treated by the Kyanize process.

The type of permanent way originally laid by Brunel was abandoned after the line had reached Maidenhead. An essential feature of Brunel's road was the cross ties or transoms that carried the longi-

tudinal timbers and the system of piles which tied the transoms. These piles were 10in. diameter and varied in length. In cuttings they were from 9ft. to 14ft. long, whilst on embankments they might reach as much as 30ft. Actually, their length was determined by the requirement that they must extend 6ft. or 8ft. into the original ground. No pile was allowed to have the head cut off; if it could not be driven to the full extent of its length it was to be withdrawn and driven again. A recess, 1¼in. in height, was cut in the pile to receive the transom. Every alternate pile had a transom on each side. The piles and, therefore, the transoms were 15ft. apart, and the latter were sufficiently long to carry two lines of way, and there was a pile for each pair of rails. The transoms were 6in. wide. The double transoms were 7in. deep and the single transoms 9in. deep.

The longitudinal timbers were of American pine, about 30ft. in length and 14in. to 15in. wide by 6in. or 7in. thick. The adjoining ends of two adjacent timbers were placed above a double transom but



ORIGINAL G.W.R. RAIL AND TIMBERS

were not directly laid thereon. In order the better to carry the load the ends were supported by a piece of timber resting on the double transom and so shaped as also to tie the two transoms together. For this reason the tops of the double transoms were 13in. below the base of the rail as compared with 9in. for the single transom. The latter, on the other hand, was slightly recessed to receive the longitudinal, and it was for this reason that it was made 2in. deeper than the double transom. The top of the longitudinal was recessed and through it and the cross tie was passed a ¾in. bolt, as shown in the accompanying illustration.

Before the rail was laid the longitudinals and transoms were well packed; so much so that the longitudinal timber took a wave-like form. This was adjusted by the timber being adzed or planed to a uniform surface, and on this surface was laid a layer of Stockholm tar. Then came some elm planking 8in. wide and 1¼in. deep, the upper surface of which was sloped inwards to give the necessary inclination of 1 in 20 to the rail. The rail was fastened on the planking and longitudinal by two screw bolts passing through the flanges.

The type of permanent way described above did not prove satisfactory. It was difficult to keep the piles at the correct level, and as they were, in a sense, the basework on which the track was built this defect was fatal. They were, therefore, abandoned west of Maidenhead, and the transoms were dovetailed into the longitudinals. The rails, too, were not heavy enough. Brunel thought that all that would be necessary was a guide for the wheels; that the passage of the train would be like a skater over ice. He was content, therefore, with a rail weighing 43 lb. or 44 lb. per yard. It was found, however, that they needed to be 65 lb. per yard. The fact that the track was too light for high-speed was mentioned in the half yearly report for January-June, 1843. It was said then that it was being replaced between London and Maidenhead.

The section between Paddington and Bristol was opened in the following order: the section nearest Bristol being opened to Bath before the line from London reached the latter place; London to the east side of the bridge at Maidenhead, June 4th, 1838; to Twyford, July 1st, 1839; to Reading, March 30th, 1840; to Steventon, May 22nd, 1840; to Faringdon-road, July 20th, 1840; to Hay-lane—Wootton Bassett—December 17th, 1840; to Chippenham, May 31st, 1841; to Bath, June 30th, 1841. The line from Bristol to Bath was opened August 31st, 1840.

The lines between Paddington and Hay-lane and between Bath and Bristol were opened before the Railway Regulation Act of 1840 became operative, and were not, therefore, inspected by the Board of Trade. The remainder of the line was inspected by Sir Frederick Smith who, after going over the section between Chippenham and Bath on June 29th, 1841, said in his report that it completed "that magnificent work which will afford railway communication between the Metropolis and Bristol."

British Wire-drawing and Wire-working Machinery.

No. XI.—BARBED WIRE MACHINES.*

Two types of barbed wire are manufactured in this country, and both are made on the same class of machine with only very slight modifications in details. The two types are known as Glidden and Iowa. In the former, a specimen of which is illustrated by Fig. 82, all the barbs are twisted round one of the two strands forming the main line, the other strand being quite plain. In Iowa barbed wire, however, one of the two barb wires is wound round one line wire, while the other barb envelops the two line wires together. The object of the Iowa arrangement is, of course, to prevent the barbs from sliding along the line wire, after manufacture, and thus spoiling the regularity of the spacing. It is claimed by some manufacturers, however, that it is possible so to adjust the machinery that the barb wires are so tightly wound round the single strand, Glidden fashion, that they will not slip appreciably. And if this desirable feature can be attained, it is advantageous, as the setting up of the machine is simplified while the amount of wire required for making the two pairs of barbs is consumed at the same rate and renewals of supplies to the machine can be made simultaneously.

Barbed wire is generally made of ordinary mild steel wire, galvanised, but there is a growing tendency to adopt high-tensile steel, especially for export trade, as the same strength can be secured with a reduced weight and transport charges are correspondingly reduced. At the same time, whilst the cost of the wire, by weight, is slightly increased, the cost, by length, is reduced. There is, however, still a certain amount of trade done in barbed wire by

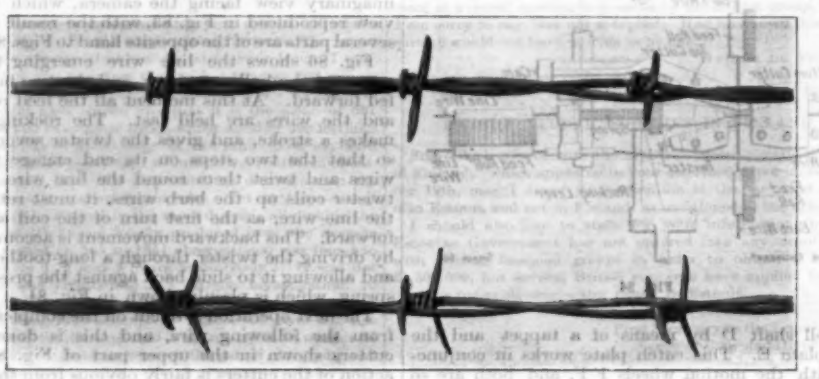


FIG. 82—GLIDDEN BARBED FENCING WIRE

weight, and then not only is mild steel used, but the barbs are made extra long, so as to add to the weight without appreciably increasing the cost of manufacture.

The two types of barb machine, already referred to, are illustrated by the engraving, Fig. 83, and the drawing, Fig. 85, while some details of the former type, which are more or less applicable to the latter, are represented in the sketches of Fig. 84.

The machine shown in Fig. 83 is made by John Hetherington and Sons, of Manchester, and is distinct from that illustrated by Fig. 85 in that the feed of the two line wires is defined positively at the inlet end of the machine.

It may be as well here to point out that in either case the wire is fed into the machine off four swifts. Two stand at the back and supply the two main line wires, which generally range from No. 10 to No. 14 in gauge, while two other swifts, which stand one on either side of the machine, provide the wire for the barbs. This wire is of much the same gauge as the line wires. The barb wires are sometimes known as "cross wires."

On reference to Fig. 83 it will be seen that there are two leading-in tubes A A for the line wires, and immediately beyond there is a pair of feed rolls, geared

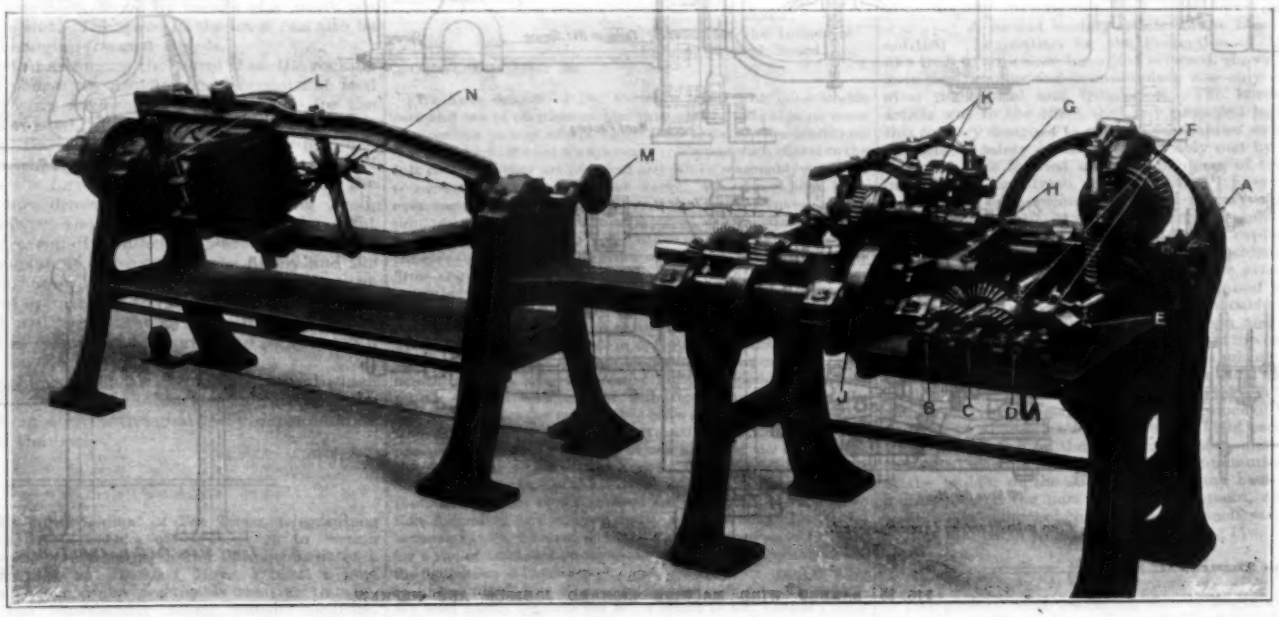


FIG. 83—BARBED WIRE MACHINE—J. HETHERINGTON AND SONS

* No. X. appeared September 26th.

together. These rolls are pressed together by springs and the wires are gripped between their plain faces. It is necessary to give the wires an intermittent feed, as they must be stopped while the barbs are being applied, and this intermittent motion is provided by the gearing in the foreground of the illustration.

The shaft B is driven continuously by the main belt pulley, seen in the background. A wheel on this shaft meshes with another on the intermediate shaft C, which also runs continuously and drives the

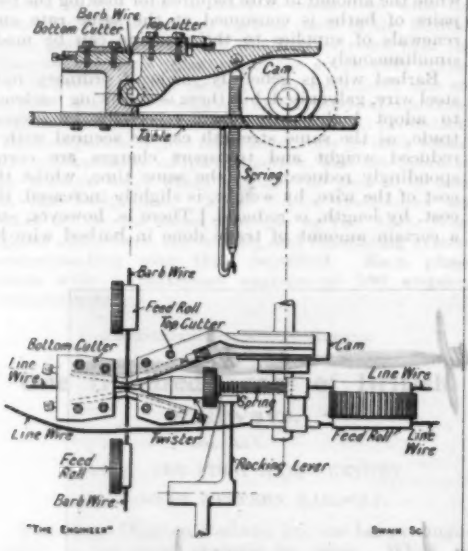


FIG. 84

feed roll shaft D by means of a tappet and the catch plate E. This catch plate works in conjunction with the motion wheels F F, and both are so formed that the wires are fed forward to the extent of the pitch of the barbs, and then held stationary for a sufficient length of time for the barbs to be formed. The shape of the several wheels naturally depends on the pitch and the length of the barbs, and different forms can be put in place, to suit the immediate requirements, quite readily.

The twister serves the purpose of wrapping the two barb wires round the line wire, and is rotated by the rocking lever H—see Figs. 83 and 84. A toothed quadrant on the end of this lever gears with a pinion on a small countershaft, which also carries a gear wheel that meshes with a pinion on the twister. The rocking motion is imparted to the lever by means of the cam J on a side shaft, which is driven by mitre wheels off the first motion shaft B.

The barb wires are fed into the machine by the two pairs of rolls K K, which are driven intermittently off the side shaft. On this shaft there is a partially toothed wheel, the plain part of whose circumference is to the front in the engraving, Fig. 83. This wheel engages with another partially toothed wheel on a countershaft, and a train of gears transmits the intermittent motion of the countershaft to the feed rolls. There are, of course, tappets on the side and countershafts to ensure that the teeth of their wheels will re-engage at the proper times. The length of wire fed forward for each barb is generally from 2in. to 2¼in., but the amount can naturally be varied by altering the feed gear.

The operation of the machine can best be followed with the aid of the diagram, Fig. 86, which is an imaginary view facing the camera, which took the view reproduced in Fig. 83, with the result that the several parts are of the opposite hand to Figs. 83 and 84.

Fig. 86 shows the line wire emerging from the centre of the hollow twister, and the two barb wires fed forward. At this moment all the feed rolls stop, and the wires are held fast. The rocking arm H makes a stroke, and gives the twister several turns, so that the two steps on its end engage the barb wires and twist them round the line wire. As the twister coils up the barb wires, it must retire along the line wire, as the first turn of the coil cannot go forward. This backward movement is accommodated by driving the twister through a long-toothed pinion and allowing it to slide back against the pressure of a spring, which is plainly shown in Fig. 84.

The next operation is to cut off the completed barbs from the following wire, and this is done by the cutters shown in the upper part of Fig. 84. The action of the cutters is fairly obvious from the sketch, but it should be pointed out that the cut is taken diagonally, at a fine angle across the wire, so as to provide points on both the completed barbs, and the following ones made at the next operation. At the time that the cut-off takes place it is important that the two first barbs should be pointing up and down, as otherwise they would be in the way of the

The speed at which the barbed wire is made naturally depends upon the pitch of the barbs, as the line wires have to stand still while each pair of barbs is being made; but some idea of the rate of progress may be gathered from the fact that the feed rolls normally deliver the wire at about 150ft. a minute, although during times of pressure this speed has been almost doubled.

After the barbs have been wrapped round one of

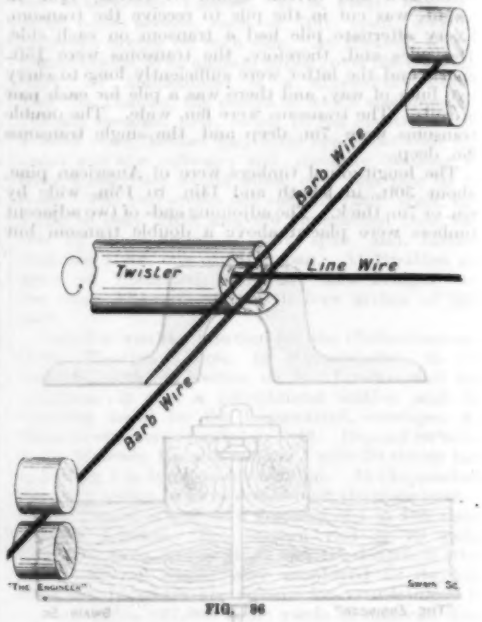


FIG. 86

the line wires, the other line wire must be twisted together with it, and this is effected by the take-off gear.

On the left of the barbing machine in Fig. 83, it will be seen, there is a cradle which carries a winder for the finished wire. This cradle is rotated by its own separate belt drive, and twists the two line wires together as they are drawn away from the barbing machine.

The finished wire is wound on to a rough wooden

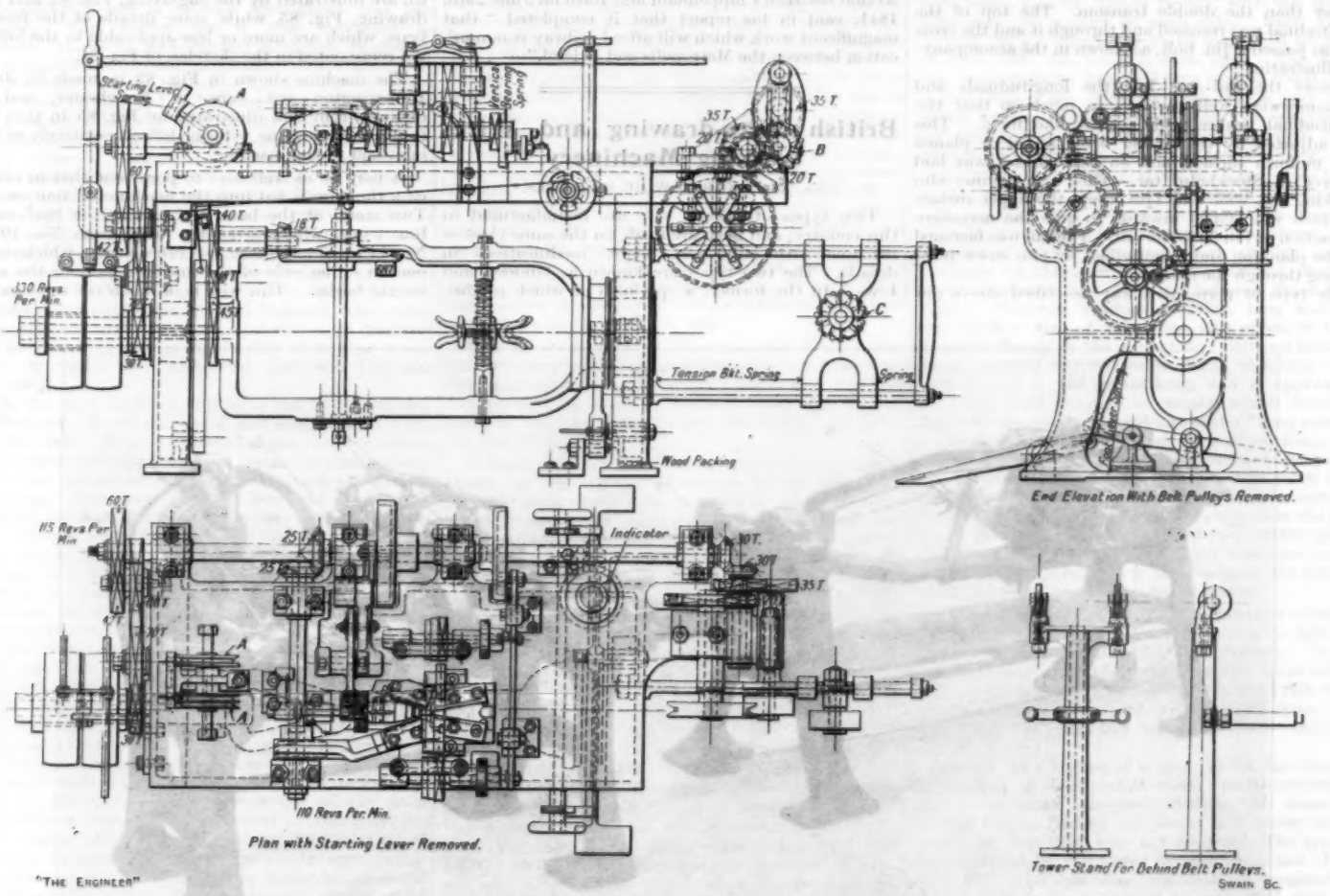


FIG. 85—BARBED WIRE MACHINE—RICHARD JOHNSON AND NEPHEW

Of the two line wires leaving the feed rolls, that in the background is led through the hollow twister G, also shown in the lower sketch of Fig. 84, while the other wire is led through a second guide tube to beyond the twister when Glidden wire is being made. (The arrangement for making Iowa wire will be described later.)

horizontal cutters, and it is one of the delicate jobs in adjusting a barb machine to get the twister to stop in the proper position to produce this effect. As soon as the barbs have been cut off, the feed rolls start again, and the whole sequence of operations is repeated, the twister being returned to its working position in the interval.

bobbin, which is mounted in the rotating cradle, and this bobbin is, in turn, rotated on its own axis by a set of gearing working in conjunction with a brake at the extreme end of the machine. This brake controls the mitre wheel L—see Fig. 83—and by retarding it, as compared with the rotation of the cradle, determines the speed of the bobbin, so that

the take-off can be adjusted to agree with the rate of delivery from the barbing machine. The tension on the brake is adjusted by means of the ratchet wheel M, with which it is connected by means of the wire shown running along the floor.

In the centre of the cradle there is a star wheel N, which is mounted on a right and left-handed screw and serves to lay the wire across the width of the bobbin. The spindle on which the bobbin works is, by the way, so arranged that it can be quickly slipped out for the removal of a filled bobbin and the installation of a new, empty, one.

So far the whole process has been followed through only in connection with the production of Glidden barbed wire, but the alterations necessary for making Iowa wire are not extensive, except that Iowa wire is always wound left-handed, as against right-hand for Glidden wire. This latter change necessitates the reversal of the rotation of the taking-off cradle, and as a consequence involves a slight modification of the gearing.

The other change necessary for making Iowa wire—that in which one of the barb wires is wrapped round both line wires—is to lead both the line wires through the twister.

The twister is provided with two separate passages for the two line wires, and the driving mechanism is so timed that when the barb wires are fed forward by their rolls the line wires are vertically above one another. Then one barb wire is directed so that it goes between the two line wires, while the other goes outside both. The twisting and cutting actions are the same as those already described.

These machines are normally rated to produce 20 cwt. of barbed wire per ten hours' shift when making 6in. pitch Glidden wire, and require somewhere about 6 to 6½ horse-power. The overall dimensions of the machine itself are 13ft. 6in. by 4ft., but, allowing space for the accommodation of the wire swifts, they require some 20ft. by 16ft. of floor space. The bobbins are generally arranged to hold 1 cwt. of wire.

The type of barb machine illustrated by Fig. 85 is that adopted by Richard Johnson and Nephew, referred to in a previous article, and is differentiated from that just described in two essential features. One is the arrangement of the winding cradle beneath the barbing gear, so that the overall length of the machine is approximately halved, while the other is the method employed for feeding the line wires. The twisting, cutting-off and barb wire feed mechanisms are much the same, except that the last mentioned is operated by a crank gear in place of the partially toothed wheels shown in Fig. 83. The line wire feed scheme is, however, totally different.

The line wires are taken from their swifts over the guide pulleys A A, round which they make a complete turn, so as to produce a slight braking effect, and then go directly to the twister. (It should be noticed that one of the pulleys has twin grooves for use when Iowa wire is being made.)

After passing through the barbing head, the wires are led over the star pulleys B and C, and then double back to the winding cradle, which operates in very much the same manner as that already described.

The star wheel B is mounted on the bottom end of a rocking lever, which is driven through gearing, from the side shaft of the machine, and can be given a variable length of stroke by means of a crank pin working in a slot. The speed of the lever can also be altered by changing the gear wheels.

The object of arranging the wheel B on the rocking lever is, of course, to provide the intermittent feed of the line wires necessary for giving time for the barbs to be twisted. The wires are constantly drawn forward by the taking-off gear, but during such time as the wheel B is moving to the left, its travel counteracts the forward pull of the bobbin, and the wires are not drawn through the barbing head. When, however, the wheel B moves to the right the wires are rapidly pulled forward as the speed becomes the sum of the speeds of the pulley and the bobbin—allowance being made, of course, for the angularity of approach of the wire to the pulley. The pulley C, it will be noticed, is mounted on a sliding frame, and is controlled by springs so as to keep a reasonable tension on the wires.

These machines are generally run at a speed which produces about 110 pairs of barbs a minute, and the length made in a given time naturally depends upon the pitch of the barbs.

THE Dublin correspondent of *The Times*, telegraphing on September 15th, speaks of rumours as to certain Americans taking an interest in the establishment of a Transatlantic port at Blacksod Bay. Whilst a port there is, we believe, more practicable than at Galway, the latter has considerably better transit facilities. Galway is only 128 miles from Dublin, and on a double line of railway throughout; Blacksod is distant about 150 miles, of which only 50 miles are doubled. To establish a service between Blacksod and Belfast, by the existing railways, would require many new connections, and the route would yet be very indirect; a service between Galway and Belfast would only necessitate a loop at Mullingar, and it would enjoy the existing 76 miles of double line up to that point.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

FATIGUE IN THE IRON AND STEEL TRADES.

SIR,—In an article published in your issue of August 15th, you somewhat severely criticise the work of the Industrial Fatigue Research Board, so far as relates to its conclusions on fatigue in the iron and steel trades. In doing so, it would appear that you have relied for your information on the recently published Report No. 27 of the Board, which briefly summarises the results of investigations made in a number of industries. Had you referred to the original Report No. 5, which describes in detail the observations made in the iron and steel trade, you would have found most of your criticisms already answered. You say in your article that the conclusions arrived at in the report were approved by representatives of the industry, but that, as you did not know their names, you preferred to rely on the opinion of the manager of an iron and steel works whom you consulted. Reference to the report would have shown you that the representatives were ten in number, and included a number of managers of iron and steel works, who were nominated by employers' associations, as well as representatives of the men, who were nominated by the Iron and Steel Trades Confederation.

Among the numerous points raised in your article, one relates to the fettling of open-hearth steel-melting furnaces. The report stated that the average time was found to vary from 27 min. to 203 min., but you maintain that such a time as 203 min. is observed only when a bad bottom develops. Yet a reference to the report would have shown you that it is the mean of 381 fettlings (observed in summer time), whilst another 390 fettlings (in winter time) gave an average of 184 min. You say that fettling depends on so many factors outside the control of operators and managers that it is impossible to dogmatise on the length of time the operation should take. Yet why was it that at three works, all situated in the same district, all making the same quality of steel from locally produced iron, the average fettling time (based on 265 to 1651 observations) was found to be approximately 1, 2 and 3 hours respectively? It was not for me, who was conducting the fatigue investigation, to attack the technical side of the problem, but surely it was worth while for the managers to attempt it. Again, you point out that it is impossible to fix the time that a charge takes to work, and that there is no co-ordination between the period of tapping and the work of the rolling mills. Yet a reference to the report would have shown that at one works the frequency of tapping (based on 1370 observations) fluctuated rhythmically from hour to hour in the proportion of 1 to 10, whilst the times for which the cogging mill was run varied as 1 to 4 in correspondence with these fluctuations.

Among other points, you say that experience has shown that the reduction of hours of work has not brought about an increase of hourly output, as stated by the Board. Obviously, the Board could only argue from the actual data which it collected, and these output data, which are quoted in detail month after month and year after year, clearly supported its contention. It is possible that other iron and steel works have met with a different experience, but have they supported it by publishing detailed information?

Finally, you maintain that iron and steel masters have better opportunities of studying the effects of fatigue than any investigating Board can have. That is quite true, but how far do they make use of those opportunities? If such investigations exist, they do not publish the results of them, and though I made many inquiries, I never heard of their existence. You point out that in steel works a continual process of survival of the fittest goes on, and that the men who are physically unable to stand the work disappear. Admitting this, ought we not to lighten the work as much as possible? Mr. Rusher and I analysed the National Health Insurance cards of 20,000 iron and steel workers for a six-year period, and we found that the steel melters and pitmen, who are physically a magnificent body of men, suffered 23 per cent. more sickness than the average and had a 26 per cent. greater mortality. Can you, Sir, look upon such facts with complacency?

H. M. VERNON,
Investigator for the Industrial Fatigue Research Board.

Oxford, September 6th.

[We have considered Dr. Vernon's letter with considerable care and can at once assure him that our attitude is in no sense antagonistic to any efforts which tend to better the conditions of the workers. We are always ready to support such efforts to the full, providing they are practical and can be reasonably expected to increase the efficiency of the works. We cannot help, however, regarding some of the efforts of the Board of Investigation, prompted no doubt by the best motives, as dangerous in so far that it expects to apply to the whole of a great industry conclusions drawn from the practice of only a small portion of the firms engaged in that industry. We do not wish to appear critical of the sources of the data on which the Board has based its recommendations, but referring to the question of fettling, we can only think that the particulars have been taken from works where some process is in operation in which the fettling times may be less frequent but longer than in the ordinary open-hearth practice. No firm could hope to operate the open-hearth furnace with success with fettling times giving the average stated in the report. We have obtained the particulars from a modern open-hearth plant, and we find that the time occupied between the tapping of one heat and the charging of the next, over a period which gives 1429 occasions, averages 100 min. The whole of this time is not occupied in fettling, but the other services of the furnace are rendered as well. If we take individual furnaces, we find that the average time varies between 84 min. for a run of 152 heats on one furnace to 107 min. for a run of 116 heats on another. Under no circumstances are the figures stated in the report approached, and we again venture to suggest that there is some misunderstanding in the matter. We need hardly traverse the other points in Dr. Vernon's communication, except to assure him that if there is any increase in output per man shown owing to the adoption of the eight-hour shifts, then there must be some reason other than normal circumstances to account for it. We have to remind him that during the period since the three-shift system has been adopted nationally, many works have been entirely re-equipped mechanically, and this is a factor which has to be taken into account. We can only say that in a works where the plant was up to date before the adoption of the eight-hour shifts, and which is still up to date, the experience has not been such as to support the conclusions contained in the report. Finally, we can again assure Dr. Vernon that our outlook on such matters as dealt with by the report is entirely sympathetic. The publication of Dr. Vernon's letter has been delayed owing to the fact that Report No. 5 was out of print.—ED. THE E.]

THE BOXER INDEMNITY.

SIR,—I see that a correspondent in China suggests that the Boxer Indemnity should be applied to the construction of a railway in China, and that the income resulting therefrom should be used for additional railway purposes. No doubt this would be good for the British engineering trade, but it would not have, if I may say so, the effect which *is* anticipated by those who urge that the funds should be applied—in accordance with the existing Bill—"for educational and other purposes." Neither the Americans nor the Japanese have adopted the course suggested, and presumably they are as wise in their generation as we are.

Your Chinese correspondent, however, is hardly up to date, because he anticipates an amount of foreign control of railways, which will never again be allowed in China. China needs communications, it is true, and if she were allowed to raise the money for this purpose by the ordinary market methods, she would have no difficulty in obtaining it. She is not, however, so allowed, owing to the existence of the Consortium; and it is clear your correspondent does not know of the proposal that was put forward at a recent meeting in London by the British group, which, I am sorry to say, was not accepted. Had he known this, I am sure he would not have written as he has.

WALTER DE FRECE.

London, September 29th.

HYDRO-ELECTRIC SCHEMES IN FINLAND.

SIR,—With reference to the article "Hydro-electric Schemes in Finland," which appeared in your esteemed paper on September 19th, may I direct your attention to the fact that Narva is in Estonia and not in Finland, as mentioned in the article?

I should also like to state for your information that the Estonian Government has not entered into any negotiations with British financial groups in order to obtain a loan of £1,500,000, but several British concerns have applied for concessions for exploiting water power in Estonia.

R. MOLLESON,
First Secretary to the Legation in charge of Consular Division.

London, September 25th.

SIXTY YEARS AGO.

IN our issue of sixty years ago we devoted one of our leading articles to a discussion of steel *versus* iron, then a topic arousing great interest. Steel had only been produced in large masses within quite recent years, but the demand for it was increasing with great rapidity. We sought in our article to dispel the opinion of some—a dangerous opinion we held it to be—that steel was simply a kind of wrought iron of double power. At the same time we characterised as mere prejudice the opinion of others that steel was an inherently brittle substance—"a kind of glass raised to the fourth power." Quoting the test figures obtained by Kirkaldy, Clark, Hodgkinson, and a number of foreign experimenters, we arrived at the conclusion that under static loads steel had a "breaking weight" on the average twice as great as that of wrought iron and at least double and sometimes four or five times the tension at the elastic limit. On the other hand, comparing the work required to rupture the two materials, we found that wrought iron showed the higher figure, and therefore concluded that it was the superior metal to employ for chain cables and other elements likely to be subjected to impulsive forces of a high value. These facts are so very familiar to us to-day that we are apt, unless thus reminded, to forget that they were only established after lengthy investigation and much bitter experience. . . . . A second leading article in the same issue was entitled "Legislation for the Protection of Life," and, like that to which we have just referred, shows that what is to-day familiar and commonplace was only established after much trial and tribulation. The burden of our article was to the effect that any proposed legislation in this country designed to prevent mechanical accidents and to promote safety of life was inevitably met by the opposition of class interest and the diffidence of the Government to assume fresh responsibilities. Every day the newspapers were recording "some railway accident, or machinery accident, or mining accident, or some wholesale slaughter caused by a boiler or a colliery explosion." It was time, we insisted, that the word "accident" should be defined, that any fatalistic significance attached to it should be eliminated and the fact recognised that every disaster was to be traced to some blameable course of action. As an example of the opposition and diffidence with which legislation for the protection of life experienced we instanced Mr. Laird's Bill for the compulsory testing of chains and anchors. Like nearly all the Acts for the protection of life on the railway, in the factory, in the mine, and at sea, it had been carried by a member of the Opposition or by an independent member. It had been defeated when introduced in the previous session and had only succeeded when re-introduced by the "undaunted tenacity of the builder of the Alabama." It had been met with indifference on the part of the Government, and certain well-known makers of chain cables and anchors had moved heaven and earth to prevent its becoming law.

Two girders—each exceeding 97ft. in length and having a height of 9ft. and a weight of 17¼ tons—have been successfully carried on the London, Midland and Scottish Railway from Reddish to Chesterfield for the Staveley Coal and Iron Company. Owing to the exceptional length of the load, the question of transport provided a difficult traffic problem. Each girder was centrally loaded on a well trolley, and to this "runners" were attached at each end to protect the overhang. The overall height was 13ft. 4in.

The Wireless Exhibition.

Since the advent of broadcasting several Wireless Exhibitions have been held, but the present show, opened at the Royal Albert Hall on September 27th, and which closes on October 8th, is the first Exhibition to be entirely organised and conducted by the National Association of Radio Manufacturers. All the receiving sets and accessories exhibited were manufactured by members of the Association and are entirely British products. During the short time that wireless telephony has been used for broadcasting, technical progress has been very rapid, and although the last Exhibition held at the White City was quite interesting and instructive, the present one is even more so. There are new loud speakers, receiving sets and component parts which have not hitherto been brought to the notice of the public.

A fact which the Exhibition has revealed is that

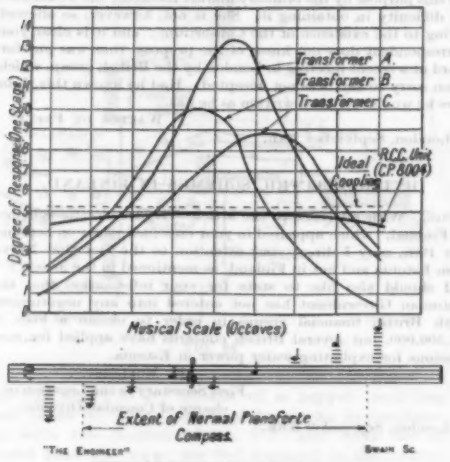


FIG. 1—TRANSFORMER TEST CURVES

there is a tendency on the part of wireless manufacturers to employ resistance capacity couplings instead of iron-core transformers for coupling together valves. There has been a good deal of discussion concerning the merits and demerits of the two systems. Distortion in present-day loud speaker sets is very often attributable to the use of iron-core transformers of inferior design. In order that the loud speaker may reproduce sounds in a realistic manner, it is necessary for the electrical vibrations to be handed on from valve to valve in a manner that ensures that the different frequencies are equally treated. Some maintain that with iron-core transformers this is impossible, because of the inductive and capacity effects and the eddy currents in the iron. There is no doubt, however, that great improvements have been made in intervalve transformers, and that some transformers give very much better results than others.

In this connection, some curves have been issued by the Radio Communication Company, of 34–35, Norfolk-street, Strand, and they are reproduced in Fig. 1. They show the performance of intervalve transformers based on tests with a cathode ray oscillograph carried out in the company's laboratories. The base line covers the frequencies obtainable on the full scale of a piano, whilst the vertical axis represents the degree of response. It will be seen that the performance of all the transformers tested varies considerably with the pitch or frequency of the signal, and that no two transformers are alike. Distortionless amplification would be represented by a line running parallel with the base line—such as the dotted line—the height above the base line representing the degree of response.

In addition to recording the vagaries of the transformers tested, the graph also shows the performance of the Radio Communication Company's "Polar" resistance capacity coupling unit, which is very satisfactory, but it also shows that the transformer gives greater overall amplification than the resistance unit. These units, which are on view at the Exhibition, are sold to amateurs and others who are interested in the clear reproduction and who have no objection to using three stages of low-frequency amplification instead of two. The General Electric Company is, however, showing some new valves specially designed for resistance capacity amplifiers, and a given number of these valves are claimed to give the same amplification as the same number of ordinary valves coupled with transformers.

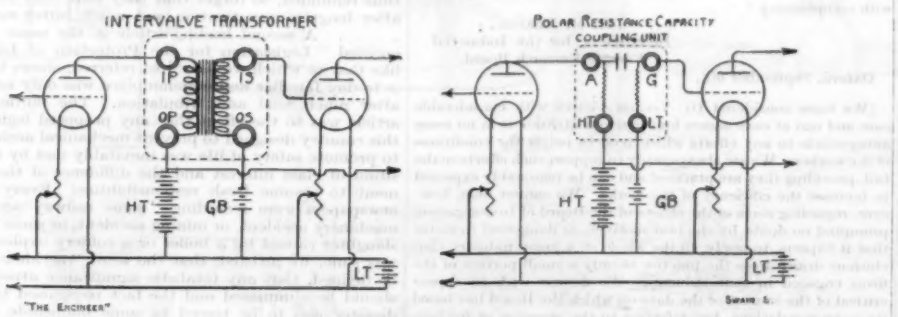


FIG. 2—TRANSFORMER AND RESISTANCE CAPACITY COUPLINGS

The anode resistance of the Radio Communication Company's units is composed of wire with small self-inductance and capacity, and as the leat capacity of the winding is considerable, the temperature rise is small. Moreover, the coupling condenser, which is manufactured by the Dubilier Company, is of a new type, specially designed for the purpose. The left-hand diagram in Fig. 2 shows the usual intervalve transformer connections, with a grid battery at G B, whilst the diagram on the right shows the connections for a "Polar" resistance capacity coupling unit, which is a strong and well-finished article.

Another firm which seems to arrive at the conclusion that resistance capacity couplings are superior to intervalve transformer couplings is the Metropolitan-Vickers Electrical Company, of Trafford Park, Manchester. Among other things this firm is showing a new valve set which can be supplied in various types of cabinets, and in order to secure pure reproduction, resistance capacity couplings are employed throughout. The set is designed for use on all wave lengths at present used for broadcasting, and the change from one wave length to another is made by changing a single plug-in unit, only three of these units being necessary to change from 300 to 3000 m. The aerial inductance, the high-frequency transformer and the reaction coil are all changed by removing the unit and by putting another unit in its place. Another novel feature is that by moving the reaction coil in one direction, it is coupled to the aerial inductance, whilst when it is moved in the opposite direction it is coupled with the high-frequency transformer. The set also works on the dual amplification principle, which makes it very efficient. Any type of valve and any combination of valves can be used without any alteration to the set, beyond the adoption of batteries suitable for the valves. All the filament resistances are provided with two windings. One winding is composed of fine high-resistance wire, suitable for controlling dull emitter valves, consuming from .06 ampère upwards, whilst the other is composed of coarse wire suitable for controlling ordinary or power valves.

The company's "Radiobrix" units were described in The Engineer on the occasion of the last Wireless Exhibition, but at the present show several new types are exhibited, including a resistance-capacity coupling unit and a high-frequency choke coupling unit. The company has introduced a new type of cabinet for these "Radiobrix" units, with a sloping front—as shown in Fig. 3—and in this cabinet any desired combination of units can be mounted, so as to form a complete receiving set of good appearance. Another of the company's exhibits is the three-valve amplifier shown in Fig. 4, and among the new components is the "Polar" precision condenser—shown in Fig. 5. This condenser has a single moving vane, which moves between two fixed vanes faced with mica saturated with a lubricating substance. The moving vane floats on the spindle between two springs. It moves very smoothly and sweetly between the fixed vanes and enables very fine adjustments to be made. The minimum capacity is less than 20 micro-microfarads, and condensers of this type are made with a maximum capacity of .003, .005 or .001 microfarad.

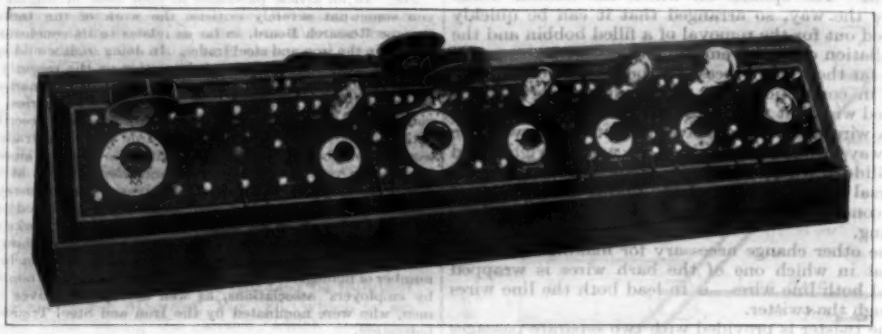


FIG. 3—RADIOBRIX RECEIVER

Reverting to the methods of coupling audio-frequency valves, it is worthy of mention that the Marconiphone Company, of Marconi House, Strand, is exhibiting a new transformer, which is claimed to give equal and efficient magnification over the whole range of audible sounds. These new transformers are guaranteed to give distortionless amplification, and they are checked for amplification at various frequencies by means of an entirely new method. They are also given a high voltage test, and a test designed to show whether there are any short-circuited turns.

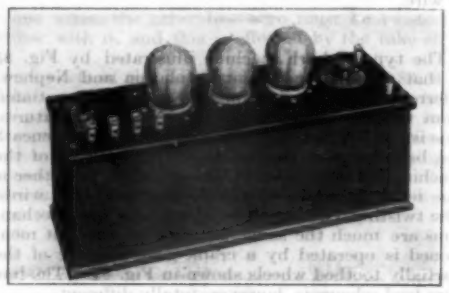


FIG. 4—THREE VALVE AMPLIFIER

They are wound for three ratios to suit different valves, *i.e.*, 2.7 to 1, 4 to 1 and 6 to 1.

Mention should also be made of the company's new single-valve receiver, which is provided with an ingenious method of changing from low to higher wave lengths. By removing a small ebonite block which contains the aerial and reaction coils and by putting a similar block in its place, the desired new band of wave lengths is secured. The reaction is controlled by means of a patented variable resistance, which possesses the uncommon property of enabling the amount of reaction to be varied without moving the turning or reaction coil, thereby avoiding any appreciable change in tuning of the circuit. An entire range of the Marconiphone receiving sets is shown, including the new baby crystal set, which can be used for reception on any of the British broadcasting wave lengths and also on the wave length of the new experimental high-power station at Chelmsford.

FIG. 5—PRECISION CONDENSER

Another firm which is showing a new intervalve transformer, designed with a view to eliminating distortion, is Radio Instruments, Limited, of 12, Hyde-street, New Oxford-street, W.C. 1. For this

transformer—a section of which is shown in Fig. 6—the following advantages are claimed :—(1) Correct inductive values of the primary and secondary windings, together with the best ratio for use with general purpose valves ; (2) minimum hysteresis, capacity and leakage losses at all frequencies between 200 and 5000 cycles per second ; (3) low self-capacity between and across windings ; (4) an efficient iron circuit ; (5) maximum mechanical strength and freedom from breakdown ; and (6) high insulation values between the individual windings and cores. The makers claim that the self-capacity of this transformer has been reduced to a value which has never before been obtained in intervalve transformer work. This reduced capacity, they explain, has removed one of the chief causes of distortion, and a greater degree of amplification is secured. When employed for amplification with power valves, a pressure of 500 volts can be used. The ratio of the transformer, which has its primary and secondary windings P.S. built up in sections and arranged as shown, is 4 to 1. The primary has 3000 turns, or 500 turns per section, whilst the secondary has 12,000 turns, or 2000 turns per section. This corresponds to a primary impedance of 11 henries and a secondary impedance of 160 henries. Some very elaborate receiving sets are shown by Radio Instruments, as well as a wave meter and various components for receiving sets.

Perhaps the most interesting feature of the Exhibition is the display of modern valves for reception and transmission. As already mentioned, the General Electric Company, of Magnet House, Kingsway, W.C. 2, is exhibiting a valve specially designed for use in resistance capacity coupled amplifiers. This valve, which is designated D E 5 B, has a high amplification factor, and it is claimed that by using this type of valve with resistance capacity couplings all the advantages of these couplings can be obtained without loss of volume. The company's four-electrode

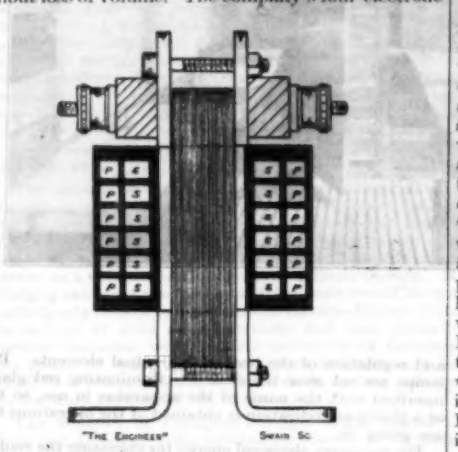


FIG. 6—INTERVALVE TRANSFORMER

valves—types F E 3 and D E 7—are also on view, the former being a bright emitter and the latter a dull emitter. The valves are fitted with standard four-pin caps, the connections to the inner grid being made by a small terminal on the side of the cap. The valves operate with an extremely low plate potential, namely, 6 to 15 volts. This potential is best applied by a separate high-tension battery, although if desired it may be obtained from the filament battery. Low-power transmitting valves, with consumptions up to 50 watts and suitable for the use of amateurs, are on view ; also high-power rectifying and transmitting valves, &c. There is an extra high-tension rectifying valve suitable for peak voltages up to 150,000, for cable testing and the electrical precipitation of dust, &c. In addition to these exhibits, there is a complete range of Marconi-Osram valves of all types.

The Mullard Radio Valve Company, of Nightingale Works, Nightingale-lane, Balham, S.W. 12, has a good display of two and three and four-electrode valves. The two-electrode valves are designed to rectify alternating current at high pressures, and are made in numerous types, with capacities ranging from 30 watts to 4 kilowatts, and passing from .08 to 3 ampères rectified current. The large valves, which have silica bulbs, will withstand peak voltages of 30,000 to 50,000 volts. The Holweck molecular pump is another exhibit. Realising that valve filaments are most frequently burnt out by the accidental application of the high-tension battery to the filament pins of the valve, the company has introduced a device which is designed to prevent the filament pins touching any metal in the valve holder until it is in actual contact with the filament supply sockets, and visitors to the company's stand are presented with the device free of charge.

The Edison-Swan Electric Company, Limited, of 123–5, Queen Victoria-street, is also among the valve exhibitors. This company has long been associated with valve work, having made the first experimental lamp with which Dr. Fleming carried out his original valve experiments. Besides ordinary bright emitter and dull emitter valves, the company is showing power valves, including a power valve of the dull emitter type. Other "Ediswan" exhibits consist of valve and crystal sets, loud speakers, high-tension batteries, &c.

A. C. Cossor, Limited, of Highbury-grove, N. 5, is showing a new dull emitter valve, known as the "Wuncell" dull emitter, which operates at a very low temperature, namely, 800 deg. A resistance incorporated in the base of the valve enables it to be used in a set in which bright emitter valves are also used without altering the wiring of the receiver. When in service the resistance enables the valve to be used with 4 or 6 volt accumulators, although the actual operating pressure of the valve is only 1.8 volts.

The General Electric is showing, in addition to its well-known "Geocphone" crystal and valve sets, amplifiers, loud speakers, components, and the valves mentioned, an entirely new range of valve sets. The single-valve set shown in Fig. 7 has the conventional

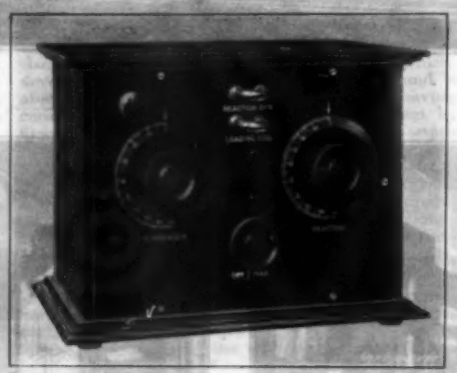


FIG. 7—SINGLE VALVE RECEIVER

reaction circuit. Tuning is carried out by a variable condenser in parallel with a fixed inductance, and a variable coupling is provided between the reaction coil and main inductance. For fine tuning a simple and neat vernier condenser is provided. With a standard "PO" aerial the set can be tuned for all wave lengths between 300 m. and 500 m. Sockets are, however, fitted in the front of the instrument for the reception of loading coils in the aerial and reaction circuits, so that the set can be made to work on higher wave lengths. A two-valve set exhibited is provided with a detector and a single stage of low frequency amplification. A notable feature of the set is the provision of a separate terminal for increasing the high-tension voltage applied to the low-frequency valve, which can then be used as a power amplifier. Provision is also made for applying a negative bias to the grid of the last low-frequency valve. A three-valve set shown is similar to the two-valve set, but it has two stages of low-frequency amplification. It is made in flat form with a vertical panel as shown in Fig. 8, and also in cabinet form with double hinged doors and a drawer beneath to accommodate the high-tension battery.

One of the chief exhibits of the British Thomson-Houston Company, of Rugby, is a self-contained three-valve set with an internal frame aerial surrounding the working parts, an arrangement which has been

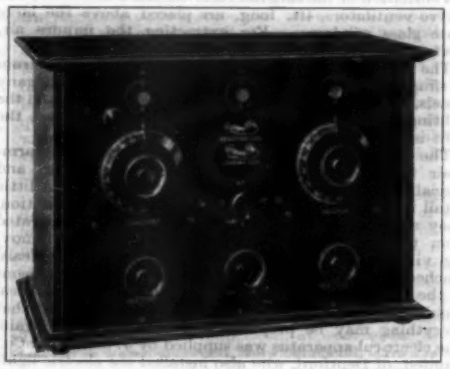


FIG. 8—THREE VALVE RECEIVER

patented. The remarkable efficiency of the B.T.H. B5 valve, which only consumes .06 ampère at 3 volts, contributes to the compactness of the design, for small dry batteries can be used for heating the filament, the cells, together with the high-tension battery, being enclosed in the receiver case. The circuit used is covered by the makers' patent No. 197,405. All the British broadcasting stations are said to have been received within a quarter of a mile of "5NO" without any trace of the local station. An exterior frame aerial of larger dimensions designed to plug into the case can be supplied, and the use of this aerial is said to increase the range of the receiver very considerably. The frame aerial is arranged so that 5XX can be received. When using the internal frame aerial excellent headphone strength is said to be obtained up to 30 to 40 miles from a British broadcasting station. For use at greater distances from a broadcasting station or for foreign transmission terminals are provided for connecting up an outdoor aerial. Various other valve and crystal sets are shown, including the Radiola model A and Bijou sets. Five types of B.T.H. valves are on view—the R type, the B5, requiring .06 ampère at 3 volts, the B4 power amplifying valve, consuming .25 ampère at 6 volts, the B6 power valve, which is similar to the B4 valve, excepting that it is designed to work at 3 volts, and the B3 valve, which requires .35 ampère at 2 volts. Other B.T.H. exhibits consist of head telephones, loud speakers, and amplifiers.

It is well known that in sets in which high-frequency valves are used special anti-capacity switches should be employed if it is desired to cut these valves in and out of circuit. The Dubilier Condenser Company, Limited, of Duncan Works, Goldhawk-road, Shepherd's Bush, London, W. 12, is showing switches for this purpose, and they are known as Minicap key switches. They are designed for panel mounting and are constructed in such a way that the capacity between the contacts is reduced to a minimum. The switches can consequently be used for switching high-frequency or low-frequency valves in and out of circuit without introducing undesirable capacity reactions between the various circuits. They can also be used as series parallel switches for aerial tuning condensers and for altering the wave length range of tuning inductances or reaction coils and for numerous other purposes. The function of the company's standard six-point Minicap switch is that of a double-pole throw-over switch, but as the capacity between opposite sides is very low it is not essential that both sides should control the same circuit. The diagram Fig. 9 shows at A one of these switches used for cutting a high-frequency valve in and out of circuit. The six thickened lines at the sides of the switch A represent the six terminal tags as seen at the back of the switch. Inefficiency in receiving sets is often attributable to the use of unsuitable switches for controlling valves, and amateurs would be well advised to pay more careful attention to this matter. Besides

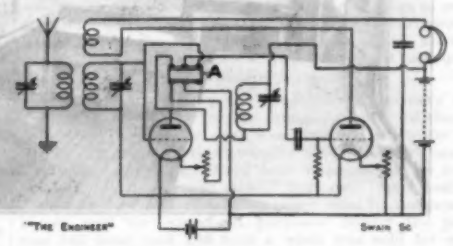


FIG. 9—TWO VALVE CIRCUIT WITH ANTI-CAPACITY SWITCH

these switches the Dubilier Company is showing its well-known fixed and variable condensers, grid leaks, anode resistances, &c.

The Western Electric Company's exhibits consist of valves, including the well-known Weeovalve or pea nut valve, receiving sets, amplifiers, loud speakers, headphones, &c. The firm's seven-valve frame aerial set is perhaps the most interesting set exhibited, for it is claimed to be capable of receiving, without the use of an outdoor aerial, British and continental stations that are situated long distances away, and it covers a wave length range of 350–3000 metres. Two and three-valve frame aerial sets are on view, and power amplifiers, which are noted for their clear reproduction. Several types of loud speakers are shown.

On the loud speaker exhibits a great deal might be written. One of the most noteworthy exhibits of this kind is a new loud speaker shown by Alfred Graham and Co., of St. Andrew's Works, Crofton Park. This is a very small instrument resembling in appearance the firm's well-known Junior Amplion loud speakers, and its price is no more than that of a good pair of headphones. For the instrument exceptional good volume and clarity are claimed.

A small but very useful wireless accessory is to be found on the stand of the Ericsson Telephones Manufacturing Company, of International Buildings, 67/73, Kingsway, W.C. 2. It is a safety Wander plug, which contains a fuse which blows at .3 ampère, and when used on the high-tension battery in place of the standard plug it protects the valves against damage in the event of the high-tension battery being accidentally connected to the low-tension filament circuit.

A. and J. Stevens, of Walsall-street, Wolverhampton, are exhibiting, among many other things, a new wireless receiver, in which a special method of stabilising the first high-frequency valve is used, and which ensures that the inductances are undamped. For the instrument a number of advantages are claimed, one being its ability to pick up and amplify weak signals.

All the exhibits of Burndept, Limited, of Aldine House, Bedford-street, Strand, are admirably finished. They consist, among other things, of Ethophone crystal sets, with a range of about 25 miles from the ordinary broadcasting stations, and 100 miles from a high-power station, such as the Chelmsford Station. The wave length range is from 250 m. to 2000 m. Two, three and four-valve sets are on view. A range of steel-clad intervalve transformers has been de-

LONDON AND NORTH-EASTERN RAILWAY—NEW KITCHEN AND DINING CARS

INTERIOR VIEWS OF KITCHEN CAR

signed by the company to suit modern valves, and they are wound with high and low ratios and for loud speaker work. Another new and noteworthy exhibit is a 45–50 volt high-tension battery with large cells, which will last for a considerable period. The cells of many of the high-tension batteries now on the market are too small for power amplification work, and a battery such as that which the Burndept Company has produced has long been needed. Another new Burndept product is a wave trap or filter which, when carefully adjusted, greatly increases the selectivity of a receiver and reduces interference of stations with wave lengths between 250 m. and 600 m. It can also be used to reduce noise from electric light mains, &c.

L. McMichael and Co., Limited, of Hastings House, Norfolk-street, Strand, are showing two, three and four-valve sets on which it is claimed all British broadcasting stations can be brought in with a reasonable aerial and under normal conditions. Continental stations and long-distance Morse signals. can also be received. This firm also specialises in the manufacture of wireless components, such as high and low-frequency transformers. The former are made in six sizes with a wave length range of 80 m. to 7000 m. The windings are placed in staggered slots on a former composed of polished ebonite, and as they are of the plug-in type they can be changed very rapidly. The low-frequency transformers, which are claimed to be distortionless, are provided with clips for the reception of a by-pass condenser.

L. and N.E.R.—New Dining-car Train.

On October 1st a new Flying Scotsman train was put into daily service. Ever since 1862 a train has left King's Cross, London, and Waverley Station, Edinburgh, at 10 a.m. on week-days, but it was not until 1879 that a restaurant car was attached to this train. It could accommodate nineteen first-class passengers, who, of course, had to remain therein until a station was reached, there being no corridors. All the cooking was done on coal ranges, supplemented by oil stoves. The new train, on which we made a trial trip from King's Cross to York and back last Monday, is, we believe, the last word in railway stock. It is made up of twelve coaches, and is carried on twenty-two bogies (forty-four axles), and weighs 370 tons. Its total length is 674ft. 7in. It is fitted with automatic couplings of the Buck-eye type and has Pullman vestibules.

Two of these trains are now in service, and two more will be ready in November. All these new cars are 1in. less in height than the present rolling stock, thereby enabling them to go anywhere on the London and North-Eastern Railway Company's system.

A few details as to cost may be instructive. The actual train with locomotive represents £42,500 travelling over the metals, made up approximately as follows:—The triple set of one kitchen and two dining cars, £11,000; the rest of the train, £24,000; and the locomotive, £7500.

The two restaurant cars with the kitchen car in the centre are carried on four bogies arranged on Mr. Gresley's articulated principle. The length overall of the triple set is 151ft., and it weighs 83 tons.

Ventilation of the cars has received much attention, and louvre ventilators, 4ft. long, are placed above the large plate glass windows,. For extracting the impure air, electric fans are placed in the roof.

The main feature of the decoration of the cars and train is simplicity. The woodwork is of polished mahogany panels, all screws being hidden. The roof is white, and the lighting has been carried out in such a manner that the light is equally distributed.

The seats in the first-class dining car are of the arm-chair type upholstered in green morocco leather, and specially constructed cushions are placed therein. A little detail in connection with the tables deserves attention. They are attached only to the floor and are separated from the carriage walls. The result is that the annoying vibration of silver is entirely prevented. Meals, luncheon or dinner, can be served to seventy-eight persons at the same time. A complete equipment of electrical cooking apparatus is installed in the kitchen car, so that everything may be prepared and cooked on the train. The electrical apparatus was supplied by J. Stone and Co., Limited, of Deptford, who also installed the electric lighting system of the train. In the kitchen, which is 14ft. by 7ft., the main cooking range is fitted across one end. On the left is a roasting oven, with a steaming oven, and grill and hot-water tank superimposed. On the right is the boiling range with six hot plates for frying, boiling or heating sauces, and one boiling pan of 7 gallons capacity for cooking vegetables, &c.

Owing to luncheon being required shortly after the beginning of the journey, and in order to minimise the capacity and weight of the battery and generating equipment to be carried, connecting plugs and sockets are provided on the train, so that when in terminal stations the supply of electrical energy for preliminary operations may be obtained from the station supply.

Every detail has been arranged in the kitchen—illustrated above—for the convenience of the *chef*. A main throw-over switch on the switchboard enables the load to be switched over from the preliminary alternating-current supply at the terminal station to the direct-current supply from the battery and dynamos before leaving the terminal station. Subsidiary boards are provided for each main group or important element of the apparatus, carrying separate switches for the control and regulation of the heat of individual elements. Pilot lamps are set over the switches illuminating red glasses inscribed with the name of the apparatus in use, so that at a glance an indication is obtained of the operations that are going on.

The necessary electrical energy for operating the cooking apparatus, while the trains are under way is provided by two of Stone's Liliput dynamos, carried on the underframe of the kitchen car, and driven by belt from an axle. A battery of accumulators is also provided. A battery overcharge-preventing switch automatically diverts a portion of the current from the batteries as soon as the fully charged condition is reached, causing the voltage to rise above a certain point and operate the switch. The current so diverted from the batteries is usefully employed by passing it through a supplementary heater applied to the warm water tanks in the corridor, the latter current, when part of the cooking load is again switched on, being automatically diverted to the cooking elements.

As a safeguard against an excessive load being imposed on the dynamos and battery while in service, an overload circuit breaker is fitted to operate when the current exceeds the normal running load, and before it will hold in—on the lever being replaced—the load has to be reduced by turning off or reducing to lower heat one or other of the cooking elements.

The cooking range, ovens, boilers, &c., were made by the Jackson Electric Stove Company. The advantages of cooking by electricity in a railway train will be apparent to everyone, but special mention should be made of the better conditions from the point of view of cooler and purer atmosphere under which the *chef* is able to do his work.

An accelerated electrolytic corrosion test, devised by Messrs. Robert J. Anderson and George M. Enos, is described in a recent paper of the American Society for Testing Materials. Briefly, the method employed for carrying out the test consists in rotating a suitably prepared test piece of the metal or alloy to be tested for corrodibility as the anode in an electrolyte consisting of the corroding medium. The cathode is a platinum wire. A current of ampèrage sufficient to yield a current density of 0.18 ampère per square dcm. of anode area exposed is imposed. The anode is rotated at convenient speed and run until a weighable loss is obtained. The test will also give ordinarily definite indication of the nature of the corrosion, *e.g.*, the kind of coating formed and pitting, if any. With mine water as the electrolyte and ordinary bronze as the anode, sufficient loss can be obtained on an eight-hour run. Experiments were made in which 42 metals and alloys, that had previously been exposed to a long-time immersion test in acid mine water, were subjected to the accelerated test. Results showed that the order of losses in both tests was the same, and that, roughly, the accelerated test was about 10 times as rapid as the long-time test.

Railway Matters.

It is reported from Tokio that an application for permission to build a cable railway up Mount Fujiyama (12,000ft.) has been filed with the Japanese Departments of Home Affairs and Railways by a group of Tokio capitalists. The Government has ordered a survey of the mountain's slopes preliminary to issuing the necessary permits.

The date for the meeting of the International Railway Congress in London next year has now been definitely fixed. It will be opened on June 22nd, and continue in session until Wednesday, July 1st. On the following day the delegates will journey to Darlington for the celebrations there and at Stockton, and on Saturday journey to Edinburgh and Glasgow, and return to London on July 6th.

Two of the members of the Institute of Transport who are to receive Gold Medals at the annual meeting on Monday next are active railway men. Mr. H. R. Griffiths, who receives the Railway (Operating) Gold Medal for his paper on "Freight Train Formations," is divisional superintendent, Bristol, Great Western Railway; whilst Mr. A. F. Bound, who has been awarded the Railway (Engineering) Gold Medal for a paper on "Railway Signalling and its Development," is the signal engineer, Southern Area, London and North-Eastern Railway.

The report by Major Hall to the Ministry of Transport on a collision at New-street Station, Birmingham, on July 19th last, has just been issued. Some empty carriages were being set back out of the tunnel at the south end of the station into No. 4 up line. The signal was lowered for this movement, but the points were not properly set, and the carriages were backed into a siding, where they came so violently into collision with a light engine that two were telescoped and a railway servant in one of them was killed. The signal applied to any one of five directions, and so the incorrect condition of the points was not noticed by the signalman.

It is with much regret that we have to announce the death last week of Sir Arthur Anderson, who, after many years as chief engineer of the Madras and Southern Mahratta Railway, joined the Indian Railway Board. Soon after war broke out he went to the Munitions Board, where, like many of his *confrères* at home, he did remarkably good work. When the Munitions Board was abolished he returned to active work on the Railway Board, of which he was then the president. His term expiring in 1921, he remained in India to serve, as one with practical railway experience, on the Acworth Committee. That duty concluded, Sir Arthur came home and became a director of his old company.

The fears experienced locally that the railway shops at Inverness would be closed now that the Highland Railway has become part of the London, Midland and Scottish Railway have been somewhat set at rest by an assurance given by Mr. H. G. Burgess, the general manager of the latter, to a deputation from Inverness Town Council. Mr. Burgess said that the interests of the town would be sympathetically considered, and that no adverse decision would be arrived at until an opportunity had been given for further discussion with the representatives of Inverness. No policy of reduction had yet been adopted, and any small local changes that had been made had no influence on the main problem of the workshops.

The Ministry of Transport's freight traffic figures for June last do not give the satisfaction that those for earlier months did. The tonnage was 14.7 per cent. less than in June, 1923, and the ton-miles were 14 per cent. lower. The comparison in the freight receipts is affected by the reduction in rates made in August, 1923, which will, in part, account for the receipts being down by 11.8 per cent. The freight train miles fell 9.4 per cent.; the average train load from 132½ tons to 126½ tons; and the net ton-miles per engine hour from 473½ to 443½. For the six months the tonnage of general merchandise increased 3.0 per cent.; live stock—owing, we assume, to foot-and-mouth disease—fell 14.3 per cent.; coal, coke and patent fuel decreased 4.8 per cent.; and other minerals increased 3.4 per cent.

When the Midland Company's line from Leicester to Hitchin was built in 1857 it made use of the Rugby–Stamford line of the London and North-Western for a distance of about a mile through Market Harborough. In the early nineties the Midland and London and North-Western companies constructed a joint station in that town, and the Midland was given its own running lines. As the route of the latter was almost north-south and the London and North-Western ran from north-east to south-west, the Midland crossed by an overbridge, and Market Harborough Junction signal-box and that at Great Bowden Junction were dispensed with. Now that both railways are part of the same system a connection has been put in at Little Bowden, which allows trains off the Midland system from Leicester direction to run over the Rugby and Stamford to Northampton and *vice versâ*, and such a service was introduced on September 22nd.

On February 23rd last a goods train was shunted from the up main to the down main line at Stoke Works Junction on the Midland section of the London, Midland and Scottish Railway, in order to allow the up mail to pass. The shunted train stood to the south of the junction leading to Worcester, and whilst standing there the down mail from Birmingham to Bristol, *viâ* Worcester, was signalled. Just as the last-named train was approaching the junction, the signalman threw his signals to "danger," and reversed the junction points, so that the mail came into collision head on with the shunted goods train. Fifteen postal officials and the guard of the mail were slightly hurt. Lieut.-Colonel Mount inquired into the accident, and the evidence shows that the signalman suddenly became mentally unfit for duty, owing possibly to his having been called upon, when going on duty, to explain some irregularity. The conclusion Colonel Mount came to was that the changing of the road "was either an act of sudden impulse, the result of a wrong and misguided impression, or it was the result of some temporary mental disorder causing such defect of reason that he did not know he was committing an error at the time."

Notes and Memoranda.

Two recent official reports on explosions concern cast iron hot-plates, and in each case the defects which caused the failures developed from the inside, where they were not readily visible. A contributory cause in one case was, it is suggested, provided by the fact that the plate was supported only at the ends of a long span. The Engineer Surveyor-in-Chief strongly recommends such steam vessels to be tested hydraulically, even when the working pressure is only 10 lb. per square inch.

Work has been put in hand for the widening of the western end of Victoria Dock, Melbourne. The work involves the construction of 2000ft. of wharves and the demolition of existing wharves which have been in use since the construction of the dock. The new wharves will be about 100ft. wide; the deck will be of concrete, 11in. thick. It is estimated that 2000 piles will be used in the work. The Harbour Trust will construct sheds at the new wharves on completion of the contract.

The year 1923 was a prosperous one for the hydro-electric companies of Italy. The industry, which is a development of great national importance and which absorbs a considerable portion of Italian savings, is considered a safe and conservative investment by the financial interests of that country. Recent statistical data give returns for 355 plants, having a capacity of 1,564,216 horse-power, with a share capital of 2,147,762,312 lire, and bond issues totalling 13,364,342 lire. The plants are valued at 2,940,604,605 lire. The total profits distributed for the year by 131 companies amounted to 146,941,911 lire—an average dividend of 6.75 per cent.

Leaks of chlorine gas should not be searched for through the sense of smell. A piece of waste dipped in liquid ammonia and fastened to the end of a stick is a simple and at the same time useful device, for when chlorine is present in the air a white fume of ammonium chloride will appear, and the fumes grow denser as the volume of chlorine increases. In this way is the leak detected. With regard to inhaling a large quantity of chlorine gas the result is inflammation of the tissues lining the throat, with coughing and nausea. While the gas is irritating and uncomfortable, it is stated to be never fatal unless the subject remains for a considerable period in an atmosphere of highly concentrated gas.

The Russian Electric Planning Commission has adopted a preliminary scheme for the financing of electrical undertakings in the financial year 1924–25. In all a total credit of 16,880,994 roubles is asked for, of which 9,427,884 roubles is in the form of grants, and 7,423,000 roubles in the shape of long-term loans. The former amount applies to the financing of the Shterof and the Nijni Novgorod stations, which are to be started next year, and also to the completion of the Schatursk, Kashirsk, and Kizelof stations. A sum of 5,314,000 roubles is also required for the organisation and extension of the production of peat for the Nijni Novgorod and Schatursk stations, as well as of the Red October works.

A survey of the costs of thirty-six hydro-electric plants in Norway, developing an aggregate of 1,450,000 horse-power, shows that the average cost has been about £20 (375 kroner) per horse-power at the power-house. During the period 1905–15 about 400,000 horse-power was developed at costs ranging from about £5 to £8 per horse-power, undoubtedly the cheapest water power developments that have ever taken place. During the World War, however, some of the costs of the plants constructed were abnormally high. The operating expenses, similar to other countries, amount to about 10 per cent. of the development cost for the larger plants, including interest and amortisation, and 12 per cent. to 15 per cent. for the smaller plants.

In the course of a lecture on the use of X-rays in industry, at the Loughborough College, Mr. J. F. Driver pointed out that when dealing with high-power rays, difficulties of danger due to exposure were increased, and the results have to be recorded on a photographic plate, as the fluorescent screen is of no use in dealing with dense substances. The present limit of practical penetration through steel using a voltage of 200,000 and a current of 3 milli-ampères is about 3in. The lecturer stated that he had been able to penetrate 5in. of cast iron. He quoted the prediction of Warren to the effect that if and when improved X-ray tubes are available enabling a voltage of 500,000 to be used, a penetration of 20in. of steel may be expected.

In concluding a paper, read before the Engineers' Society of Pennsylvania, on the "Manufacture of Seamless Steel Tubing," Mr. W. C. Chancellor said that there had been a tendency on the part of consumers, in some cases, to limit the manufacturer in the amount of reduction to be given a tube—the limit, of course, being a maximum. Experience indicated, however, that instead of being a safeguard, such limitation might lead to serious difficulties. The results of heavy reductions, at least so far as seamless tubes were concerned, were beneficial. Recrystallisation which took place at the proper temperatures, following heavy reduction, left the material in a fine grained condition and resulted in very good ductility for corresponding tensile strength. Owing to conditions peculiar to the tube-making industry, there was no danger of overdrawing, as the result of heavy reduction, such as was found in the wire industry.

A material for filling the expansion joints in concrete work comprises an intimate mixture of crude unvulcanised rubber with resin, in the proportion of one part of rubber to about ten of resin. To the mixture is added a considerable quantity of a neutral pigment giving a tint as nearly conforming to that of concrete as possible. This material may be melted in open kettles at the roadside, although the melting takes longer than that of bitumen, and may be filled into the cracks satisfactorily with the use of a hot iron implement. The advantages of the material are that it is highly ductile, is much less affected by temperature changes than the bituminous materials commonly used, it does not become brittle in cold weather, it shows no tendency to flow out or bleed, and stands up exceedingly well under traffic. The manifest disadvantage is that this new filler costs about three times as much as do those of bituminous materials.

Miscellanea.

Another German torpedo-boat destroyer, the G 38, was raised in Scapa Flow on the night of Saturday, the 27th ult.

An oil tanker 450ft. long is to be built for the Union Steam Shipping Company, of New Zealand, at the Hessle Yard of Livingstone and Cooper, Limited.

The operation of getting the suspension cables for the Delaware River Bridge in place is well under way and 6550 tons of wire—about 97 per cent. of the total required—has now been manufactured.

The New Brunswick Electric Power Commission is commencing surveys on Green River in connection with the examination of storage facilities for hydro-development at Grand Falls. The proposed plant will have a capacity of about 60,000 horse-power.

It is officially announced from Paris that as a result of boring undertaken by the French Government, petroleum deposits have been discovered near Gabian, in the Department of Hérault, which borders on the Mediterranean. The borings are yielding at the rate of about 6 gallons an hour.

At Dande, in Angola, an oil well is being sunk, and is already more than 2000ft. deep; some sort of heavy oil has been coming up from this well. At Cunga, 75 miles from Loanda, a well was sunk which reached 4000ft., and there, also, a heavy oil of a brownish colour and molasses-like consistency appeared.

The Housing Committee of Glasgow Corporation has confirmed the decision of the Sub-committee on Sites and Houses accepting the offer of Lord Weir to erect ten steel houses as an experiment. One steel house will be built in Kelvin Hall for public inspection at the forthcoming Domestic Welfare Exhibition.

The Cape Copper Works at Briton Ferry, South Wales, one of the oldest copper smelting works in the country, has been bought by George Cohen Sons and Co., Limited, of London. The works have been in existence for over a century, and have a capacity of about 12,000 tons of refined copper a year. They have been closed since 1920.

The Australian Commonwealth Premier, Mr. Bruce, has announced that the British Admiralty is complying with the Government's request and supplying plans and specifications for the two new 10,000-ton cruisers to replace the Melbourne and Sydney, for which the Government has decided to ask for tenders, both in England and Australia. The cost of the plans and specifications would be from five to six thousand pounds sterling.

Figures supplied by the Australian Electricity Commissioners show that for the first six months of the year 62,618 tons of brown coal was obtained from the open cut at Morwell. Of this quantity 6061 tons were used for household purposes, 10,351 tons were classed as engine coal, 43,955 as "run of mine," 2483 as "nut" coal, and 1768 tons as slack. The average weekly demand for brown coal for household purposes during the period was 242 tons, and 296 tons a week was sold for power generation.

A new form of rustless steel, named "Stabrite Silver Steel," which is being produced by Thos. Frith and Sons, has a yield point of from 12 to 15 tons per square inch and from 55 per cent. to 70 per cent. elongation. It can be cold-pressed with comparatively little effort, and to a considerable degree—far more indeed than "stainless irons." The new steel can be turned, milled, planed and welded by the electrical and oxy-acetylene processes. Soldering, brazing and tinning present no difficulty. It is claimed that the material is not affected by such substances as tartaric, citric, formic and lactic acids, or by phosphoric acid in all strengths.

The power station at Yangchow, Kiangsu Province of China, has recently installed a 300-kilowatt electric light engine. The new engine was bought from the Jardine Engineering Corporation, Shanghai, and consists of a 450 brake horse-power "National" gas engine fed by a 500 horse-power "National" suction gas plant. The power station was started with an 80-kilowatt steam engine and later a 180-kilowatt Bellias and Morcom steam engine was added. There followed a 50-kilowatt Crossley gas engine, and three years ago a 100-kilowatt Crossley gas engine was added. The present engine is said to be one of the largest suction gas engines of its kind imported into China.

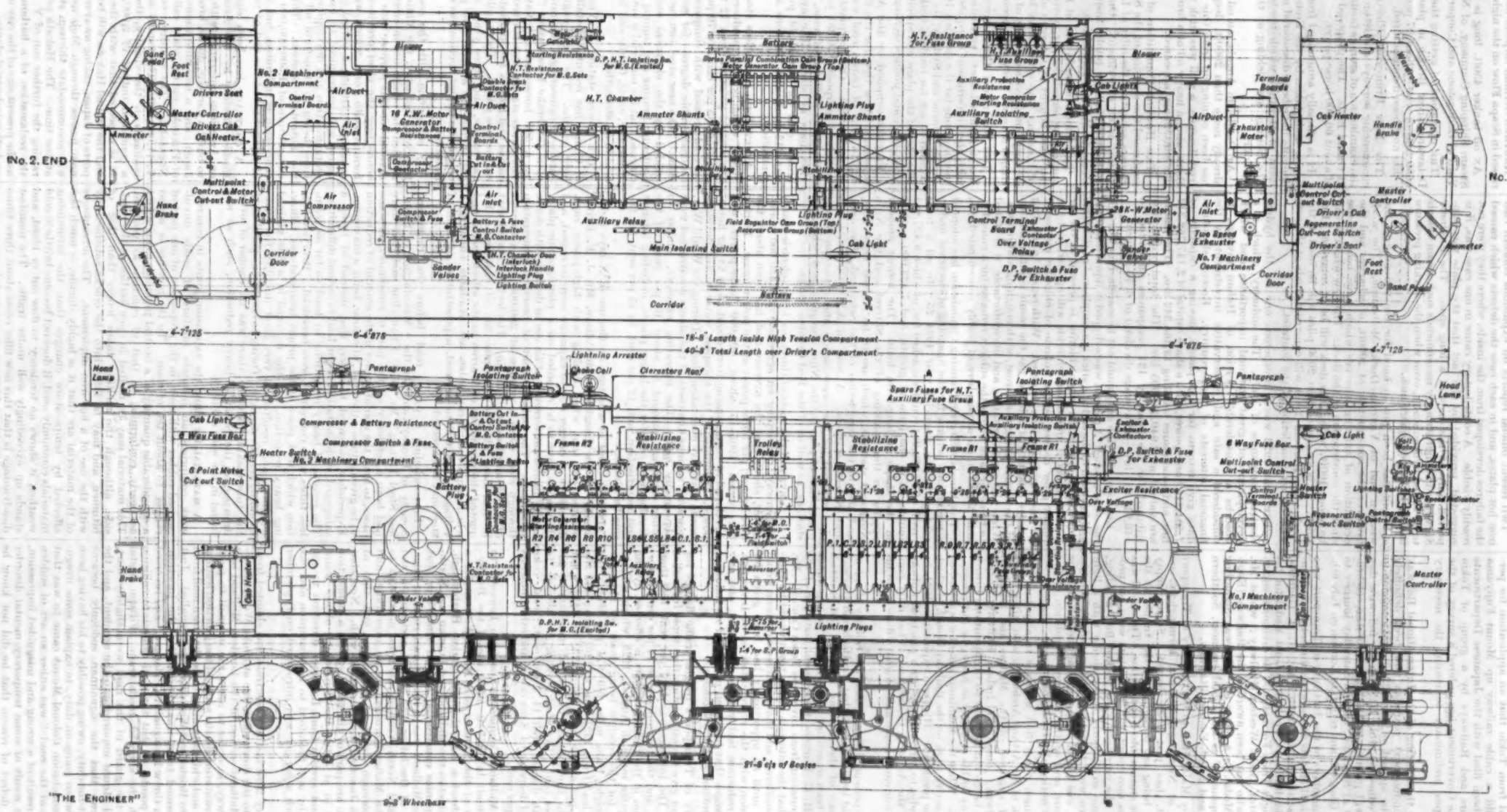
In connection with the cession of telephones in Italy to private industry, the Minister of Communications has notified the companies interested that the country will be divided for this purpose into five zones. The great lines connecting the chief provincial and regional towns will form a sixth zone, which will be conceded to a single company. During a period of ten years the concessionnaires will be required to execute a vast programme of reorganisation and development, one of their first obligations being to transform all the stations and introduce the automatic system. This programme involves an expenditure of 1,500,000,000 lire. The duration of the concession is unlimited, but the State reserves the right of repurchase at the end of twenty years.

A contract has been signed, according to the *Far Eastern Review*, by the Asia Development Company—an American enterprise with head offices in Shanghai—to build a harbour, docks, breakwater at Hakata, Kyushu, Japan, and a two-mile tunnel to connect with the town of Fukuoka on the main railway line between Moji and Nagasaki. The entire contract will approximate Y. 11,000,000. The tunnel is intended to tap the many coalfields in the vicinity, the richest in Japan, having a combined output of 2,000,000 tons of coal annually. It is expected that with the completion of the harbour and the tunnel Hakata will become one of the most active ports of Japan, taking away much of the coal traffic which now passes through Moji and Nagasaki. The harbour will accommodate thirteen steamers of 10,000 tons each at one time. The Hakata people are also contemplating raising the further sum of Y. 80,000,000 in the future for the reclamation of a harbour area three times as large as the present size of the city and erect a large iron foundry and other industrial plants.

EMPIRE EXHIBITION—ELECTRIC LOCOMOTIVE FOR THE SOUTH AFRICAN RAILWAYS

METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED, MANCHESTER, ENGINEERS

(For description see page 370)



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DEATH.

On the 26th September, at 19, Daleham-gardens, Hampstead, Richard Fuge Grantham, M. Inst. C.E., F.R.G.S., of 5, Little College-street, Westminster Abbey, elder surviving son of the late Richard Boxhall Grantham, M. Inst. C.E., and husband of Adela Grantham, aged 78.

THE ENGINEER.

OCTOBER 3, 1924.

The Distribution of the Fleet.

Important changes in the distribution of the Fleet, foreshadowed in the Navy Estimates of 1923–24 and confirmed in the Admiralty Memorandum on the current Estimates, are now in progress. For something like twenty years past our naval policy has been to concentrate the major part of our naval strength in home waters. That policy was inspired by the growing power of Germany's sea armaments. It was already in train when Lord Fisher became First Sea Lord in October, 1904, but under his direction it was carried out with a thoroughness that evoked much criticism from the older school of strategists. For a century the Mediterranean had been the focal point of British sea power, and naval students imbued with the Victorian tradition which postulated France and Russia as our only serious rivals at sea found it difficult to readjust their mental outlook when the German menace suddenly arose. Few of those who look back from the vantage point of to-day will question the wisdom of the dispositions which Fisher proceeded to make. Under his *régime* the foreign stations declined to secondary importance. Thanks to the Japanese Alliance and, subsequently, to the crushing defeat of Russia in the Far East, it was no longer necessary to maintain a powerful fleet on the China station. At a later date our commitments in the Pacific were further narrowed by the decision of Australia to provide herself with a self-contained naval unit of no mean power. It was, indeed, fortunate for us that these events coincided with the early development of the German menace. At the same time the political genius of King Edward VII. was smoothing the way for an Anglo-French reconciliation which had far-reaching effects on the naval situation. We were free at last to relax our grip on the Mediterranean and transfer it to the North Sea. Germany, as she avowed in the notorious preamble to her naval programme of 1900, never reckoned on having to encounter the full weight of British power when she chose to make her bid for the trident. Her plans were laid on the assumption that the moment of crisis would find our fleets dispersed over the globe. As events turned out, however, we were never so well prepared to meet attack in the Narrow Seas as when she threw down the gage of battle. On the outbreak of war nine-tenths of our strength was massed in or adjacent to the North Sea. From the very start the German fleet was held in check by a superior force, nor did it ever recover from the moral ascendancy which our pre-war dispositions imposed upon it.

But with the collapse of German sea power the entire situation underwent a radical change. The motives which impelled us to mass all our best ships on the home front have ceased to apply. The German fleet has virtually disappeared, and nowhere else in Northern waters is there any naval force of imposing dimensions. Hence, the fleet organisation which prevailed after the war was at variance with strategical requirements. The North Sea and the Channel could be guarded effectually by a force much smaller than we were maintaining there. It was clear that if the British Navy were called upon to exert its power at any time within the discernible future, the theatre of operations would lie somewhere to the east of Gibraltar. That being so, the Mediterranean was obviously marked out as the area in which our strongest fleet should be stationed. Our cordial relations with France and Italy preclude the notion that any special political significance attaches to the reinforcement of the Mediterranean Fleet. It is simply that Malta has become a more convenient base than Portsmouth or Devonport for our principal battle squadrons. Those who are dubious as to the wisdom of the new policy may set their minds at rest by studying the atlas, together with a table of nautical distances. They will find, for instance, that Malta is 2000 miles nearer than England to the Pacific, to which ocean the attention of naval strategists is now being attracted. For the past few years the Mediterranean Fleet has consisted of six battleships—"Iron Duke" and "King George V." class—two being in reserve at Malta, one light cruiser squadron, and two destroyer flotillas. It was joined early this year by the aircraft carrier Eagle. As reorganised next month, the Fleet will contain two battle squadrons, two cruiser squadrons, four destroyer flotillas, one submarine flotilla, and the aircraft carriers Eagle and Hermes. The eight battleships will be the Queen Elizabeth, as fleet flagship; Barham, Valiant, Malaya, Iron Duke, Marlborough, Benbow, and Emperor of India—comprising the First and Third Battle Squadrons respectively. This force will not be homogeneous either in speed or armament, for the "Queen Elizabeths" are 25-knot ships, mounting 15in. guns, while the "Iron Dukes" are four knots slower and carry 13.5in. guns; but the composition of the Fleet is no doubt provisional, and may be altered as further material becomes available. The transfer to the Mediterranean of the fifth "Queen Elizabeth" unit, the Warspite—now undergoing refit—and of the battleships Nelson and Rodney, when they are completed, would conduce to a higher degree of uniformity in speed and gun power. For the time being, at any rate, our battle-cruisers are to remain with the Atlantic Fleet. In a sudden emergency their great speed would enable them to reach the Pacific from England almost as soon as the battleships which sailed from Malta. From now onward the Atlantic Fleet will contain but one battle squadron—the Second. Admiral Sir Henry Oliver, the Commander-in-Chief, flies his flag in the Revenge, the other four units being the Royal Sovereign, Royal Oak, Ramillies, and Resolution. These sister ships constitute a powerful and homogeneous force. Their speed is 23 knots, all are fitted with anti-torpedo bulges, and they mount in the aggregate forty 15in. guns. As noted above, the Battle-cruiser Squadron is to form part of the Atlantic command. The Hood and Repulse, which are due at Plymouth on Sunday, September 28th, on the conclusion of their voyage round the world, will rejoin the Atlantic Fleet on October 9th. In due course the squadron will be reinforced by the Renown, which is being thoroughly refitted at Portsmouth. Our fourth and last battle-cruiser, the Tiger, is in service as a gunnery training ship. When the new disposition of the Fleet has taken effect we shall have absolutely no reserve of capital ships. Under the Washington Treaty we are bound to discard our four oldest battleships—King George V., Ajax, Centurion, and Thunderer—immediately the Nelson and Rodney are placed in commission. By that time the British battle fleet will consist of twenty ships, a total that seems grotesquely small in view of the world-wide interests for which the Navy is responsible. Always in former times we had, behind the fleet in commission, a substantial number of older but still effective armoured ships, which were available either to augment the fighting line or for subsidiary operations. Henceforth we shall have to dispense

with such a reserve, and the fact can scarcely fail to exercise a profound influence on the future development of tactics and strategy. Knowing that the number of capital ships is strictly limited, and that casualties in this type cannot be replaced, naval commanders of to-morrow will assuredly hesitate to expose the battle fleet save in the last resort. Rather will they seek to force a decision by means of their lighter material. Apparently, therefore, the cruiser, the destroyer, and the submarine are destined to play a more important part in the scheme of tactics than has fallen to them hitherto. This prospect, coupled with the ever-present requirements of commerce protection, furnishes a potent reason for maintaining our establishment of such craft at an adequate standard of strength.

It is gratifying to observe the equanimity which responsible circles in France are displaying towards the expansion of our Mediterranean Fleet. The good sense of our French neighbours tells them that this policy implies no menace to their own interests. In fact, the composition of our new fleet at Malta tends to disprove the assumption that its object is to dominate the Mediterranean. It is strongest in battleships, a type which, for all its particular and valuable qualities, would operate at maximum disadvantage in the comparatively restricted waters of the Middle Sea. Had our purpose been to challenge one or other of the States on the coast, we should hardly have sent such vessels as the "Queen Elizabeths" to Malta. French and Italian naval men are firmly of opinion that the command of the Mediterranean will be secured by the Power which is able to develop a superiority of strength in small, high-speed surface craft, submarines, and aeroplanes, nor is there any reason to suppose that British strategists dissent from that view. It is as an ideal training ground, and still more as a convenient point of departure for ships which may be called upon to operate much further afield, that the Mediterranean is again becoming the principal station of our Fleet. We would point out, however, that since the Admiralty's plans for the defence of the Empire postulate the creation of a major naval base in Eastern waters, we cannot, so long as the Singapore scheme is held up, hope to enjoy that measure of security which our naval power, if properly utilised, could undoubtedly confer.

The Supply of Research Workers.

It is frequently said by practical engineers that when trade is bad they cannot afford to undertake extensive research and development work, and that when trade is flourishing they have not time to do so. There are in truth good grounds for believing that industrial progress by way of research or otherwise reaches its greatest activity in the twilight periods preceding or following a spell of good business. With a feeling of advancing prosperity development work is encouraged, with a view to taking full advantages of the "boom" when it comes, and as the tide begins to recede efforts are made to stave off the depression by the production of new designs or by taking advantage of new and more economical processes. These conditions, though natural and understandable, are clearly not ideal, for sound progress in technological matters, as in all else, cannot be made satisfactorily by fits and starts, but must be continuous. To realise the truth of this assertion, we need only consider the position of the research worker. Five years of specialised study following a normal period of general scientific training is by no means an unduly long time for the creation of an able research worker in chemistry, physics or engineering. His is a difficult profession, and few, relatively, of those who feel called to it can hope to attain eminence in it. Like that of all who follow a deeply scientific career, the ability of the research worker must be given continuous exercise in order that it may not deteriorate. It is absurd to suppose that satisfactory research workers can be picked up when required and dismissed immediately trade conditions render the continuance of their employment unnecessary. If for no other reason such a system would stand condemned on the ground that it would definitely discourage or debar from the profession of research the very pick of those qualified by natural gift and training to enter it.

It is a subject for anxious thought whether in the depressed state of industry we are to-day training research workers of the right kind and in satisfactory numbers. Obviously, it is quite out of the question to await returning prosperity before seriously concerning ourselves with the supply of such workers, for long before they could be given or acquire the necessary high standard of knowledge the wave of good trade, it is almost certain, would have passed. To whatever period the initiation of research and development work may be postponed by reason of commercial considerations, to whatever extent such work may be undertaken spasmodically, the training of research workers ought to be continuous and their employment secured against the vagaries of dull and bright trade. A certain amount of information on this subject is to be gathered from the figures relating to the grants made to students and research workers given in the annual report of the Department of Scientific and Industrial Research. Last year grants were made to 252 students in training and this year to 244. Of last year's students, 124 had their grants renewed this year, the remainder, 128, taking up various forms of scientific, research or scholastic work. The new students in receipt of grants this year therefore number about the same as those who passed on from the student stage, so that fresh recruits are coming forward in sufficient numbers to balance the departures. To that extent the position is satisfactory. But is an annual recruitment of 120 or so to the ranks of our research workers sufficient for our needs? We are aware, of course, that recruits are forthcoming from sources other than the ranks of the students in receipt of the Department's grants, but we also know that of the students who attain the status of research worker more than a few do not continue to prosecute the calling and that some are never likely to rise above the post of research assistant. It is difficult or impossible to estimate the country's total need of research workers, but there are grounds for believing that the Department itself is not satisfied with the number at present available. However it may be as regards the total number, there is no doubt that the position is unsatisfactory when the distribution among the sciences of the students in receipt of grants is examined. It is remarkable, for example, that chemistry and biology between them should account for 75 per cent. of the students, whilst even the group studying physics, mathematics and astronomy, representing 12½ per cent., is as great as that devoting attention to engineering, metallurgy, geology and aeronautics. Nor is the position satisfactory when we examine the figures relating to the grants awarded to actual research workers and research assistants as distinct from students in training. During the past three years the number of such grants has fallen from fifty-five to thirty-five. Whether that diminution has been caused by the attainment of positions of independence, by a closer discrimination on the part of the Department, or by the withdrawal of discouraged workers, we will not pretend to be able to say. We note, however, that in this category the distribution of the grants among the sciences is again remarkable, 60 per cent. going to workers in chemistry and biology and only 23 per cent. to those dealing with geology, metallurgy, engineering and aeronautics. Only two of the workers in receipt of grants are directly investigating engineering subjects.

On the strength of the Department's statistics, it might fairly be concluded that chemistry offers, or is held to offer, a far better chance of success to the research worker than any other branch of science. The position of the chemist in the chemical factory, the iron and steel works, the paper and textile mill, the food industry and many another branch of manufacturing activity is well established and recognised without dispute. The chemist in such undertakings is regarded—and rightly so—as a necessity, and holding, as he frequently does, his employer's reputation in his hands, occupies a key position. These facts are more than sufficient to explain why so many of our future research workers choose chemistry as their profession. Is the research worker in the engineering establishment, devoting his attention to physical, mechanical and electrical matters, less necessary than the chemist in other factories? We might conclude from the figures presented to us by the Department that he is. There are no doubt quite a number of engineering establishments which can continue in satisfactory business without the services of a research worker, in which all the development work required can be conducted by the head of the firm or an assistant. But even excluding such establishments, we cannot believe that the need for research workers in the engineering industry is justly reflected in the Department's statistics. Rather are we inclined to take the view that the demand for research workers in engineering and metallurgical establishments is below what it ought to be partly because many firms still fail to recognise an obligation in the matter which should be as great as that involved in the engagement and training of craftsman-apprentices, and partly because there is still a deficiency in the quality of the workers available to meet the demand.

Scientific and Industrial Research.*

The report, just issued by the Stationery Office, of the Committee of the Privy Council for Scientific and Industrial Research for the year 1923–24 is the ninth which that body has submitted. As usual, it is accompanied by a report submitted to the committee by its Advisory Council, a body presided over by Sir William McCormick and consisting of twelve well-known scientific engineering, and other authorities. We give below a summary of the Council's report.

Estimates.—The estimates for the programme of research work and for administrative services for 1924–25 have been approved at £328,281, as compared with £276,863 for 1923–24 and with £297,437 for 1922–23. The increase of £51,418 for the current financial year has been received with especial satisfaction by the Council, for it follows a warning in last year's report that without increased funds the Council would not be able to carry out effectively the duties laid upon it by the Government.

Research Associations.—The work of nine research associations which have reached or are about to reach the end of the five-year grant period has been reviewed with the object of determining whether, and if so, to what extent further grants should be made to them. These associations are those connected with the cement, woollen, boot, scientific instrument, cotton, linen, cocoa and sugar, glass and non-ferrous metals industries. The scientific value of the work done by the associations has been investigated by a visiting committee, consisting of at least two persons of high scientific standing unconnected with the department. The reports submitted by these visiting committees are confidential, but in general, it is stated, they show that the associations are fulfilling their objects and that the scheme for their foundation as a whole has justified its inception. "Foundational research" planned to expose the basic scientific facts underlying a broad range of technical operations, and not to be of immediate industrial utility, is in the majority of cases reported to form a most satisfactory proportion of the associations' work. In three instances the visiting committees reported that the amount of consultation work being done was unduly great, but while the Council naturally dislikes encouraging with State subsidies competition between research associations and ordinary consultants, it recognises that it is very difficult to lay down a limit to the amount of such work which a research association should undertake. With one exception the visiting committees reported that the associations were being administered economically. Of the nine associations visited that connected with the cement industry is to receive no further grant, as it is now being sufficiently supported by its trade subscriptions. The associations for the woollen, boot, scientific instrument and cotton industries are to receive further grants on a diminishing scale during the next five years. Negotiations for the continuation of grants to the linen and cocoa, &c., associations are now in hand, and the position of the non-ferrous metals association has still to be considered. The Glass Research Association, in the matter of the scientific results achieved, failed to impress the visiting committee as favourably as did the others. In addition, the financial position of the industry affords no prospect that the firms will be prepared to subscribe funds sufficient to justify the continuance of a research association for this trade.

Fuel Research.—Increased activity is reported in the work of the Fuel Research Board. The staff of the Fuel Research Station has been augmented and arrangements have been made whereby any promising plant for the low-temperature carbonisation of coal may be tested and reported upon by the department at the public expense. In addition, the physical and chemical survey of the national coal resources is being pressed forward at the maximum possible speed, but the rapidity with which it can be conducted is limited by the number of competent and trained workers available. On the subject of low-temperature carbonisation in its technical aspects the Council's report contains a paragraph obviously intended for the benefit of the general public and designed, we take it, as a caution against extravagant hopes. The paragraph is as follows:—

"Low-temperature carbonisation of coal is attractive, since it produces both smokeless solid fuel useful for domestic and industrial purposes, and a supply of motor spirit and of liquid fuel needed for the Navy and mercantile marine. It would not be a specific for all our troubles, even if it could be profitably adopted for the 40 million tons of coal annually used in domestic fire-places. Owing to the variation in the

* Abstract of report for 1923–24, submitted to the Committee for Scientific and Industrial Research by its Advisory Council.

coals available, and in the local conditions, a number of different processes will possibly have to be devised before success on a national scale is achieved. It is quite certain that no single process has yet become established which would be suitable for application on a national scale. Before it would be feasible to prohibit the use of raw coal in our homes, it is therefore necessary to find a process and a type of plant—or a number of processes and types of plant—which, collectively, would pay their way when the raw coal is purchased at approximately the same price as coal now sold for household or other general purposes."

Geological Survey.—The increased establishment recommended last year as being necessary to enable the Geological Survey Board to revise more frequently geological areas of economic importance has now been brought into being, and a good beginning has been made with the first season's work in certain new areas.

Building Research.—The Building Research Board originally intended to serve a temporary and experimental purpose is to be continued for at least another five years. Two new committees are to be set up by it, one to deal with problems relating to structures and the other with the study of building materials.

Co-ordinating Research Boards.—The difficulties experienced by the Chemistry Research Board through a lack of suitable laboratory facilities are now being met by the erection of a chemical laboratory adjoining the National Physical Laboratory at Teddington. The building has been planned on modest lines, but to be capable of easy expansion, and will, it is hoped, be ready for occupation by the end of this year. The Chemistry Board has now taken over the general study of the corrosion of metals, for which purpose a committee has been set up under Professor Carpenter, with Dr. G. D. Bengough in direct charge of the investigations. In view of this arrangement, the grant hitherto made to the Institute of Metals in connection with the study of the corrosion of condenser tubes and of aluminium is to cease. The work of the Oxygen Research Committee has also been taken over by the Chemistry Board. The Council remarks that while it is fully alive to the industrial possibilities of the use of oxygen on the large scale, it has not yet had brought to its notice any method of cheap manufacture, except as a by-product of other industries. Regarding the work of the co-ordinating boards as a whole, the Council reports that it is becoming more and more effective, that the boards gave a good deal of attention to the programmes of research in various Government Departments, and that it was found useful to arrange special conferences and visits in order to ensure close co-operation.

Illumination Research Committee.—The Illumination Research Committee set up within the year has submitted a preliminary programme of research, calling for the co-ordination of physical, physiological, and engineering studies. Two sub-committees have begun work, one on the nature of illumination necessary for difficult factory processes, and the other on the architectural aspects of illumination.

Current Meters Investigation.—The Current Meters Committee has completed its work, and submitted its final report, but is to be kept in being to assist any authority that may be set up to undertake an actual survey of the flow of the country's rivers and streams. Regular gaugings on the river Severn, it is proposed, should be continued by Professor S. M. Dixon, of the City and Guilds College.

Stresses in Railway Bridges.—The Bridge Stress Committee has found it necessary to begin the study of its complex problem by carrying out much work of a detailed nature on the instruments to be employed in the large-scale trials. A staff has been established, with headquarters at York, and a new type of continuously recording deflectometer has been constructed. A special train has been fitted out by the railway companies to facilitate the transport of the staff and the instruments to bridges in different parts of the country. It is proposed to correlate the data obtained from the recording instruments with particulars of the locomotives used in the tests and with determinations of the natural periods of vibrations of the bridges.

Machine Design.—The Engineering Research Board is to secure appropriate representation on a committee appointed by the Medical Research Council to study the mechanical side of an investigation into problems of machine design in relation to the comfort and efficiency of the operator. The object of the investigation is somewhat vaguely described as the demonstration to industry of the value of studying the design of the machine operated in relation to the requirements of the operator. The investigation is to be assisted for a limited period with funds supplied by the Department.

Researches Aided by Grants.—No further grants are to be made to the following institutions in connection with the research work indicated after their names:—Institute of Metals (corrosion of condenser tubes and of aluminium); Institution of Heating and Ventilating Engineers (heat emission from radiators); Liverpool Tidal Institute (tidal investigations); Manchester Association of Engineers (lathe tools). Grants have been continued to the Institutions of Mechanical Engineers (cutting tools) and of Civil Engineers (deterioration of structures exposed to sea action), and to the British Empire Sugar Research Association. The Ferrous Alloys Research at the National Physical Laboratory, on behalf of which Sir John Dewrance made an appeal some time ago, is not now meeting with the support experienced at the outset. Realising its importance, the Council hopes to be able to arrange for its continuance, though on a reduced scale.

Individual Research Workers and Students.—During the year 577 applications for grants were received from individual research workers and students, as compared with 668 during the previous year. Awards were made in the case of 291 as against 304. The standard of work done by the students receiving assistance has been definitely raised, and their reports, it is recorded, show a clear advance, both in subject matter and style. In only one case did the report fall so far short of the standard as to lead to the grant being terminated. Bad work and bad style, the Council remarks, frequently are found to go hand in hand, and this alliance, it is held, clearly points to a defective general education and too early specialisation. Chemistry continues, with 141 students specialising in it, easily to head the list of the subjects of study among the grantees. Biology with 41 comes second, and indeed outnumbers the combined total (31) for geology and mineralogy (4), metallurgy (10), engineering (16), and aeronautics (1). The grants to individual research workers, other than students in training, show a very similar distribution.

Protection of Scientific Property.—A memorandum submitted by the Committee on Intellectual Co-operation of the League of Nations, covering a proposed international convention for the protection of scientific property on lines analogous to those of letters patent and literary and scientific copyright, has been reported upon unfavourably by the Department. Its memorandum has formed the basis of the British Government's official reply. The Council holds that the nation and the Government should do their utmost to secure adequate means of livelihood to the man of science, but strongly urges that the community and the original investigator would alike suffer if the seeker after new knowledge were encouraged to lay claim to a share in the profits that may accrue from the subsequent applications by other workers of purely scientific discoveries to productive ends.

Literature.

Chemistry of the Rarer Elements. By B. Smith Hopkins, Professor of Inorganic Chemistry, University of Illinois.

This book, by an American author, may be regarded as a useful summary of modern knowledge concerning the methods of production, the properties and the uses of the rarer elements and their compounds. "Rare elements" are defined in the author's preface, as those elements which are little known on account of scarcity, neglect or ignorance. The book may be confidently recommended for the use of students as an auxiliary to a university course of lectures. It is up to date (1923), accurate and explanatory; is well printed, and contains a good index.

The author is to be congratulated upon condensing so large an amount of information into so small a volume. But it must be understood that the work is not, and could not be, unless greatly enlarged, anything more than a good summary of the subject matter. A measure of compensation for brevity is, however, provided by the inclusion of a large number of references which should be useful, not only to students, but also to practical scientific men.

A chapter on the periodic system forms an introduction to the subject, and in the subsequent chapters, the rarer elements are considered in groups in the order given by the periodic table. In the case of each element, following a short historical introduction there are described the methods available for the extraction and isolation of the element, its uses and the nature and uses of its more important compounds. Methods of analysis are briefly indicated.

An excellent feature throughout the book is the relatively large space devoted to the consideration of the uses of the various substances concerned in science and particularly in the arts. This method of treatment adds much to the interest of the subject, and includes in its appeal, not only chemists, but also others, such as engineers and metallurgists. The chapter on radium and radioactivity is particularly interesting and informative. The fact that until recently America held a world monopoly in the production of radium, gives to the reader the comforting idea that the information regarding the radium industry given by an American professor should be up to date and reliable. The sections dealing with those of the rare metals that are used in the manufacture of special steels are well worth perusal by anyone interested in the special steel industry.

It is rather a pity that the author did not include a short illustrated chapter on modern electric furnaces, for such would have formed an appropriate addition to the book. These furnaces have attained a high degree of importance in the metallurgy of the rare metals and their ferro-alloys, and a description of the principal types would certainly not be irrelevant, in spite of the fact that electric furnaces are not "rare elements."

Professor Smith Hopkins evidently has a good knowledge of the subject, and he imparts his knowledge with admirable lucidity. He has done good service, not only in filling a gap in chemical literature, but also in endeavouring to stimulate interest and enlighten ignorance, and therefore to prevent future neglect, by presenting the subject in a concise and readable form.

Spectroscopy. By E. C. C. Baly, C.B.E., M.Sc., F.R.S., Grant Professor of Inorganic Chemistry in the University of Liverpool.

Owing to the great advances that have been made during recent years in the science of spectroscopy, the author has found it convenient, in this the third edition, to divide his book into two volumes. In Vol. I two chapters are devoted to an interesting historical introduction. The next five chapters deal with the theory, construction and use of modern spectroscopic apparatus. Chapter VIII. comprises sixty-three pages on "The Extreme Infra-red and Ultra-violet Regions of the Spectrum"; while in Chapter IX. the practical resolving power of the spectroscope is discussed. The text is well printed, profusely illustrated and furnished adequately with references in the form of footnotes. Separate indexes are provided for authors and subjects.

The book is well up to the standard of the excellent series of which it forms a part, namely, the "Text-books of Physical Chemistry," edited by the late Sir William Ramsay and Professor F. G. Donnan. Since the author has catered ably for those engaged in work requiring a practical knowledge of spectroscopy, the book is advanced, and presumes the reader's knowledge of the elements of the subject. The amount of mathematical theory included is the minimum possible for adequate treatment. On the other hand, the practical side is expounded in detail, lucidly and with knowledge born of experience. This method of treatment is a very valuable feature of the work, which, instead of being a mere catalogue of facts, is not far inferior to a living instructor in practical spectroscopy.

BOOKS RECEIVED.

Prospectus of University Courses in the Municipal College of Technology, Manchester. Session 1924–25.

Reinforced Concrete Design. By G. P. Manning. London: Longmans, Green and Co., Limited, 39, Paternoster-row, E.C. 4. Price 21s. net.

Marine Structures: Their Deterioration and Preservation. By W. G. Atwood and A. A. Johnson. U.S.A.: National Research Council, Washington, D.C.

Eighteenth Annual Report of the Bengal Smoke Nuisances Commission for the Year 1923. Calcutta: Bengal Secretariat Book Depôt. Price 10 annas.

Elasticity and Strength of Materials Used in Engineering Construction. Section V.: Economic Theory of Steel Railroad Bridge Design. By C. A. P. Turner.

Transactions of the Institution of Chemical Engineers. Volume I., 1923. London: Institution of Chemical Engineers, Abbey House, Westminster, S.W. 1.

Combustion in the Gas Producer and the Blast-furnace. By A. Korevaar. London: Crosby Lockwood and Son, Stationers' Hall-court, E.C. 4. Price 15s. net.

Practical Microscopical Metallography. By R. H. Greaves and H. Wrighton. London: Chapman and Hall, Limited, 11, Henrietta-street, W.C. 2. Price 16s. net.

Regulations for the Electrical Equipment of Buildings. Issued by the Institution of Electrical Engineers. London: E. and F. N. Spon, Limited, 57, Haymarket, S.W. 1. Price 1s. 6d. net.

University College of South Wales and Monmouthshire in Association with the School of Mines. Treforest Joint Diploma in Coal Mining. Regulations and Schemes of Study, Session 1924–25.

Report on the Financial, Commercial and Industrial Situation of Austria, Revised to July, 1924. London: H.M. Stationery Office, Imperial House, Kingsway, W.C. 2. Price 1s. 6d. net.

A Hundred Years of Portland Cement, 1824–1924. By A. C. Davis. London: Concrete Publications, Limited, 35, Great St. Helens, Bishopsgate, E.C. 2. Price 21s. net cloth binding, and 25s. leather.

City and Guilds of London Institute, Department of Technology. Programme and General Regulations for the Year 1924–1925. London: John Murray, Albemarle-street, W. 1. Price 3s. 6d. net.

The Incorporated Swansea Exchange, Royal Metal Exchange, Swansea. Thirty-sixth Annual Report, Statement of Accounts, List of Members, &c., for the Year 1922–3. Swansea: Ernest Davies and Co. (1919), Limited, Fisher-street. Price 3s. 6d.

French-English and English-French Dictionary of Technical and General Terms, Phrases, and Abbreviations. By J. O. Kettridge. London: George Routledge and Sons, Limited, Broadway House, 68–74, Carter-lane, E.C. 4. Price 10s. 6d. net.

Research Department, Woolwich. R.D. Report No. 62. A High Vacuum Pump and its Mode of Action. Price 1s. 3d. net. *R.D. Report No. 61. The Properties of Medium Carbon Steel with High Manganese Content.* Price 1s. 6d. net. London: H.M. Stationery Office, Imperial House, Kingsway, W.C. 2.

Moulding and other Foundry Work. By W. Bell. *Pressure Gauges, Indicators, Thermometers and Pyrometers.* By James Smith. *Patternmaking.* By J. McC. Wilson. Practical Manuals for Practical Men Series. Edited by James Smith. London: Constable and Co., Limited, 10–12, Orange-street, Leicester-square, W.C. 2. Price 3s. 6d. net per volume.

Machine Tool and Engineering Exhibition at Olympia.

No. V.*

THE COLCHESTER LATHE COMPANY.

A WIDE range of lathes of different patterns was to be found on the stand of the Colchester Lathe Company, of Hythe, Colchester. Among them was the all-geared surfacing and boring lathe, illustrated in Fig. 63. The bed of this machine is 7ft. in length, and is provided with a 9in. gap piece in front of the chuck, which, when removed, permits work up to 36in. in diameter to be accommodated. The bed is 24in. wide, including an outer support beneath the saddle apron. In unison with the company's present-day practice, the gears and shafts in the headstock are made of hardened steel, and all the shafts, except the main spindle, run in ball bearings. Twelve spindle speeds, ranging from 5 to 208 revolutions per minute, are obtainable. The sliding and surfacing and the screw-cutting feeds are transmitted through a train of gearing external to the headstock, but guarded by a cover, and through a quick-change gear-box giving thirty-two feeds, from 8 to 120 cuts per inch, or thirty-two thread pitches, from 4 to 60 threads per inch. The leading screw is cut from a master screw, which has been certified by the National Physical Laboratory to have a maximum error of 0.00065in. per foot. The customary precautions are taken to prevent the engagement of more than one speed or feed simultaneously, and to interlock the screw-cutting, sliding and surfacing controls. The makers inform us that the lathe is capable of cutting ¼in. deep in a cast iron ring at a cutting speed of 185ft. per minute, and at a feed of twelve cuts per inch.

A second type of lathe which was shown by the company was that which we illustrate in Fig. 64. This lathe, known as the "Bantam," is arranged for motor driving with an alternative foot treadle drive. It has a bed 48in. in length, and will admit work up to 24in. between the centres. A diameter of 7in. can be swung over the saddle, but in the gap work up to 14in. in diameter can be admitted. The compound slide rest with which the lathe is fitted is furnished with a holder to take either round or square tools.

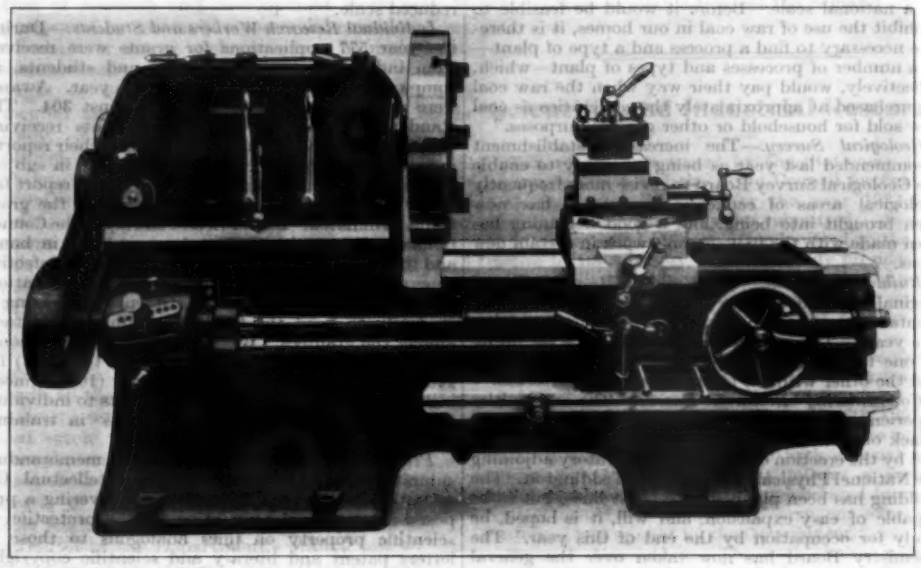


FIG. 63—36-INCH SWING ALL-GEARED SURFACING AND BORING LATHE—COLCHESTER LATHE COMPANY

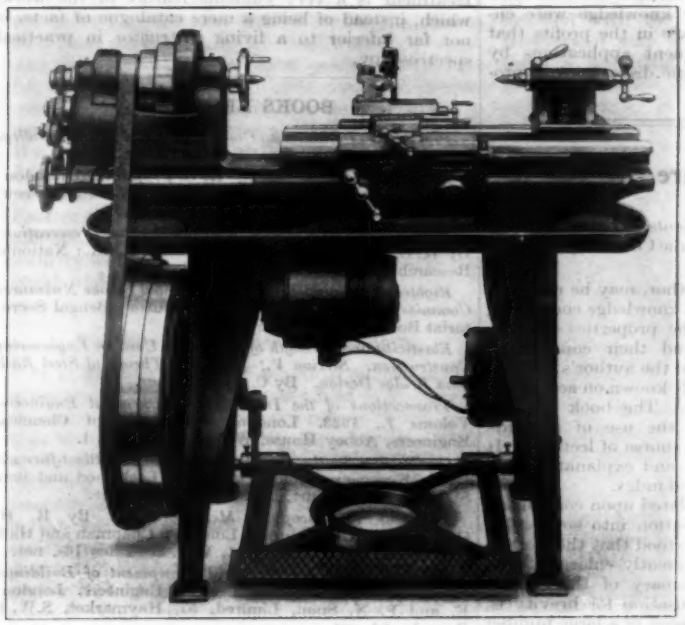


FIG. 64—5-INCH CENTRES "BANTAM" LATHE—COLCHESTER LATHE COMPANY

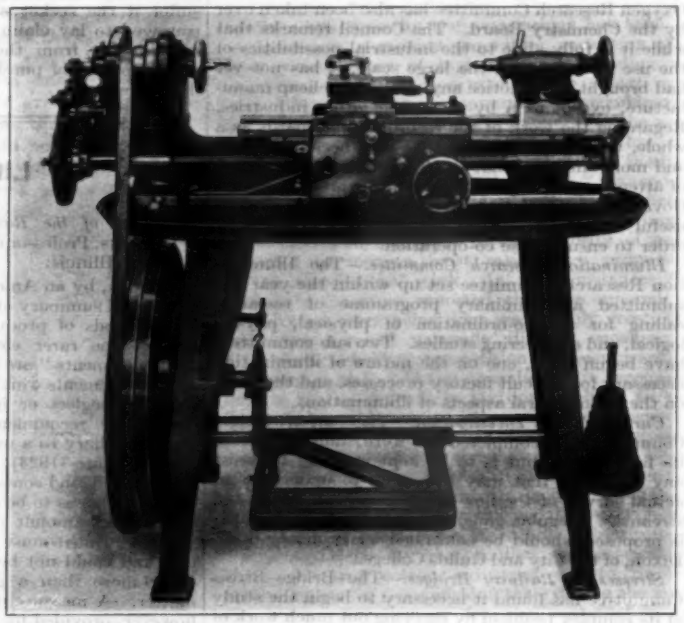


FIG. 65—4-INCH TREADLE LATHE—BRITANNIA LATHE AND OIL ENGINE COMPANY

In Fig. 66 we reproduce a photograph of a 9½in. centres all-geared lathe, which formed a conspicuous feature among the firm's exhibits. This lathe, although of a different type, embodies the same standard practice as is represented in the lathe shown in Fig. 63. The headstock is totally enclosed, and is formed with an oil bath, whereby all the gear wheels contained in it are lubricated. The main spindle is of high-carbon steel, and runs in phosphor-bronze parallel bearings. All the other spindles in the headstock run in ball bearings, while the thrust on the main spindle is taken on a ball thrust washer. Twelve spindle speeds, ranging in geometrical progression from 7 to 290 revolutions per minute, are provided. The loose head is carried on a split base for taper

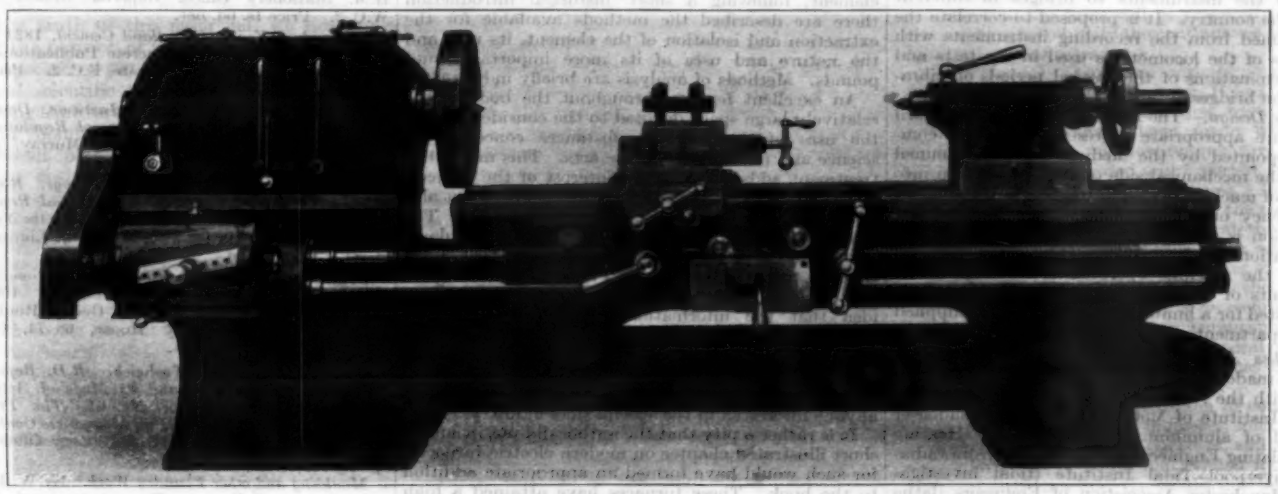


FIG. 66—9½-INCH CENTRES ALL-GEARED LATHE—THE COLCHESTER LATHE COMPANY

* No. IV. appeared Sept. 26th.

turning. Its spindle passes through the hand wheel, which itself forms the nut. The bed is 17in. wide and 10ft. long, and is formed with a removable gap piece in front of the face plate. The saddle apron, it is claimed, is of an improved type, which permits the easy engagement of the sliding and surfacing feeds by means of a single lever working in a gate. Rigidity in the apron has been secured by arranging it with double walls and by giving every gear wheel two bearings, so that none may overhang. All the wheels in the apron run in oil baths. The handle for racking the saddle is balanced, and is geared down to the rack in order to provide an easy sliding movement. The leading screw is of ¼in. pitch, and is used exclusively for screw cutting. A quick-change gear-box is provided, and by it thirty-two thread pitches from 2 to 30 threads per inch, or thirty-two feeds from 8 to 120 cuts per inch can be obtained. The lathe has been designed throughout to take more power with safety then the belt can transmit, so that an ample margin of strength is secured. A length of 5ft. can be admitted between the centres, and diameters up to 14in. can be swung over the saddle.

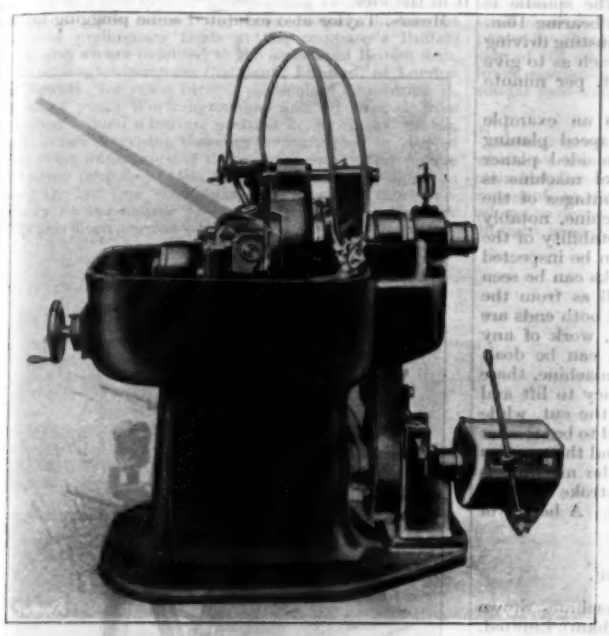


FIG. 67—"COVENTRY" CENTRELESS GRINDER—B.S.A. TOOLS, LTD.

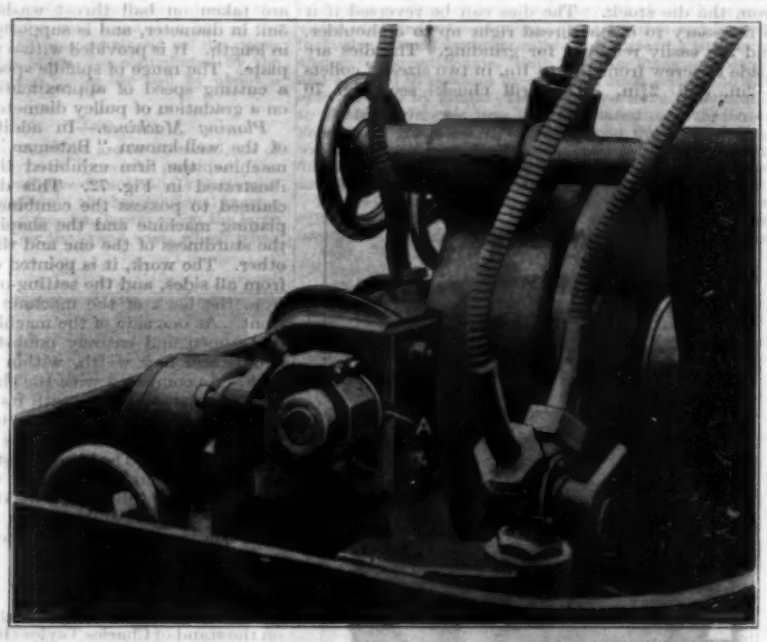


FIG. 68—WORK HOLDER OF "COVENTRY" CENTRELESS GRINDER—B.S.A. TOOLS, LTD.

The Britannia Lathe and Oil Engine Company, Limited.

4in. Treadle Lathe.—Although the lathe exhibited by the Britannia Company, of Colchester, is sold as nominally 4in., the height of the centres of the new model has been increased by ¼in., so that it will actually swing 8¼in. in diameter over the bed. The hole through the mandrel has also been increased in bore to $^{9}/_{16}$in. The length which can be accommodated between the centres is 25in.; but with an extra long bed 4ft. 6in. long, the distance is increased to 37in. The gap is 6in. deep by 4¼in. wide.

One of the most novel features about the lathe is the arrangement for adjusting the height of the cutting tool. On the top of the top slide there is a separate plate for carrying the tool, which is supported on inclined ways. When the holding-down bolt is slacked off, the plate can be moved up or down the ways by means of a screw, and a vertical adjustment of about ¼in. is thus obtained and a proper level maintained all the time. Another very handy little fitting on this lathe is the device used to hold the change wheels on their studs. It takes the form of a spring steel washer shaped very much like the petals of a daisy. This washer is slipped on a reduced part of the stud, and outside it there is a small knurled nut. When the nut is screwed up, the washer spreads out and locks the wheel in place, but if the nut is slacked back the washer contracts and the wheel can be slipped over both the washer and nut.

The mandrel, which is of special toughened steel and has a 1in. nose with an ¼in. thread, runs in roller bearings, while the thrust is also taken on rollers. The tailstock can be set over for taper turning, and has two locating screws, an index and an adjustable zero. Both the chip tray and the gear guards are now made of pressed sheet steel. A useful departure from orthodox practice, which considerably increases the capacity of the gap, is the screwing of the chucks directly on to the mandrel nose without the intervention of a back plate. The slide nuts are now made in two parts, so that they can be adjusted for wear. The machine is supplied either as a bench lathe, for power or treadle driving, as shown in Fig. 65, or with a self-contained electric motor.

On this stand there is a number of the flow meters for measuring such flows as lubricating oil or petrol supplies, which were described in THE ENGINEER of November 16th, 1923.

B.S.A. Tools, Limited.

Centreless Grinder.—On the stand of B.S.A. Tools, Limited, a noteworthy exhibit was the "Coventry" centreless grinder, which we illustrate in Fig. 67. This machine, like others of its class, is designed to grind small rollers and similar cylindrical parts by causing them to pass across a grinding wheel in a holder which supports them, with freedom to rotate and to move endwise. An enlarged view of the work holder and a section of it are given in Figs. 68 and 69 respectively. The work, it will be gathered, is borne between top and bottom bevel-edged plates, and a power-driven roller lying behind the plates. The work projects between the plates just sufficiently far to permit the grinding wheel to make contact with it without touching the plates. The work holder is set at a slight angle to the horizontal—about 3 deg. or so—with the result that under the action of the wheel the work is traversed through the holder without the application to it of any positive feed. The greater the inclination of the holder the faster is the traverse of the work, so that for roughing cuts the holder is inclined more steeply than it is for finishing cuts. The chief feature of the machine lies in the fact that the work is ground against the face of the wheel and not, as in other makes of centreless grinders, against the periphery. The wheel used is of cup formation. The work traverses across one the lip of wheel and is then received on an inclined shoot which carries it past the other lip. The blanks are fed in by hand in rapid succession at the point A in Fig. 69. The rotary speed of the work is controlled by varying the speed of the power-driven roller behind it. Cooling liquid is delivered to the work from a pump in the base through a connection on the top of the work holder—see Fig. 69. The liquid is delivered through a two-way valve, which can be operated to switch the supply over to a diamond wheel dresser forming a fixture on the front of the wheel casing. The work holder is carried on a slide operated by a feed screw and hand wheel graduated to read to 0.0005in. It is claimed that with this machine production times are from one-quarter to one-sixth and, in particularly favourable cases, even as low as one-tenth of those obtained on machines grinding between centres.

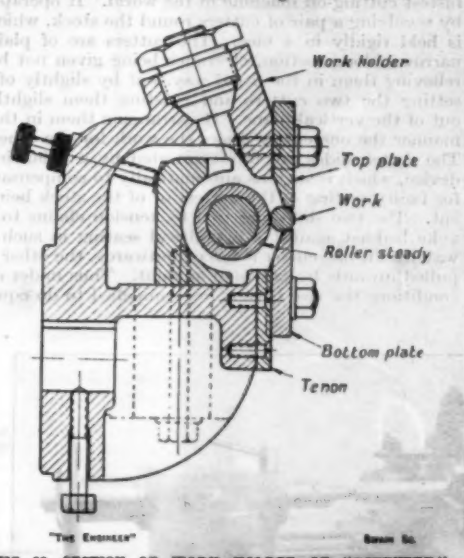


FIG. 69—SECTION OF WORK HOLDER OF "COVENTRY" GRINDER

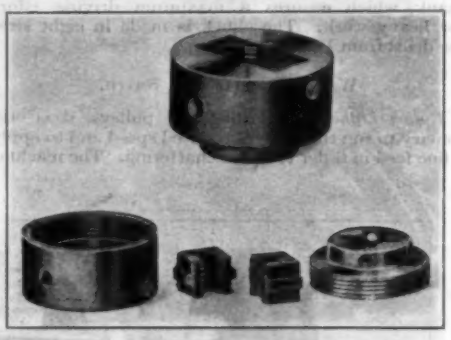


FIG. 71—ADJUSTABLE DIE—B.S.A. TOOLS, LIMITED

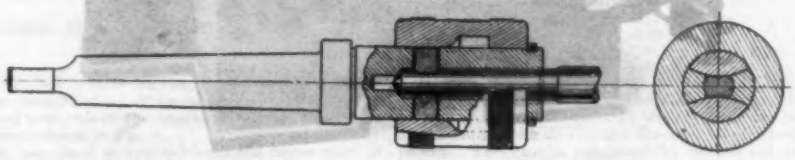


FIG. 70—QUICK-CHANGE DRILL CHUCK—B.S.A. TOOLS, LIMITED

Small Tools.—Among the small tools shown by the company two of the most novel were those illustrated in Figs. 70 and 71.

The adjustable die and holder—shown in Fig. 71—

has been introduced to meet the demand of those users who prefer a self-contained collet with rectangular dies and independent adjustment, and its construction is so obvious in the engraving that it really needs no description. One of the adjusting screws can be seen in the illustration. The adjustment can be effected without removing the collet from the die stock. The dies can be reversed if it is necessary to cut a thread right up to a shoulder, and are easily removed for grinding. The dies are made to screw from ¼in. to 1in. in two sizes of collets—2in. and 2¾in. The drill chuck—see Fig. 70

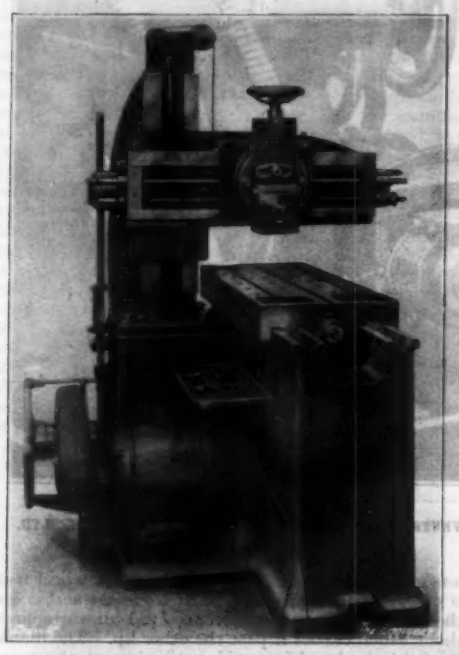


FIG. 72—OPEN-SIDED PLANER—WARD, HAGGAS & SMITH

—is of the quick change type, that is to say, the drills can be changed while the machine is running, and is used in conjunction with a specially designed drill shank, which ensures a maximum driving effort for heavy work. The chuck is made in eight sizes for drills from ¼in. up to 1 9/16in.

WARD, HAGGAS AND SMITH.

Pulley Lathe.—In turning belt pulleys, it is customary to run the work at reduced speed and to apply a fine feed in order to avoid chattering. The machine able from a gear-box, and automatic trips are provided for the feed in each direction. The crowning of the pulleys is effected by means of a radial cam engaging with a roller beneath the transverse slide. The machine is driven from a four-stepped belt pulley through worm reducing gear, running in an oil bath. The thrust of the worm shaft and that of the spindle are taken on ball thrust washers. The spindle is 5in. in diameter, and is supported in a bearing 16in. in length. It is provided with a self-adjusting driving plate. The range of spindle speeds is such as to give a cutting speed of approximately 40ft. per minute on a gradation of pulley diameters.

Planing Machines.—In addition to an example of the well-known "Bateman" high-speed planing machine, the firm exhibited the open-sided planer illustrated in Fig. 72. This design of machine is claimed to possess the combined advantages of the planing machine and the shaping machine, notably the sturdiness of the one and the adaptability of the other. The work, it is pointed out, can be inspected from all sides, and the setting-out marks can be seen from the back of the machine as well as from the front. As one side of the machine and both ends are quite open and entirely unobstructed, work of any length and any width, within limits, can be dealt with. As compared with the shaping machine, there is no overhanging ram with its tendency to lift and move sideways under the reaction of the cut, while the table, not being overhung, is claimed to be steadier and more rigid. The length of stroke and the position of the table can be adjusted while the machine is running. The table has a maximum stroke of 24in., a length of 46in., and a width of 18in. A height of 17in. can be admitted under the arm.

CHARLES TAYLOR, LIMITED.

Cutting-off Machine.—Among the machines shown on the stand of Charles Taylor (Birmingham), Limited, of Bartholomew-street, Birmingham, the rotary cutting-off machine—illustrated in Fig. 74—was perhaps the most noteworthy. This machine is designed to deal normally with round or square bars, tubes and other stock up to 3in. in diameter, but with a few simple adjustments it can be made to accommodate diameters up to 4in. It is claimed to be the fastest cutting-off machine in the world. It operates by revolving a pair of cutters round the stock, which is held rigidly in a vice. The cutters are of plain narrow oblong section, clearance being given not by relieving them in the usual way, but by slightly offsetting the two cutters and twisting them slightly out of the vertical plane. By arranging them in this manner the one cutter clears the work for the other. The cutter slides are interconnected by a balancing device, which is such as automatically to compensate for faulty setting of the cutters or of the stock being cut. The two slides are tied by tension chains to a yoke bedded against a cylindrical seating in such a way that if one cutter is forced outwards, the other is pulled inwards by an equal amount. Thus under all conditions the two cutters are compelled to do equal

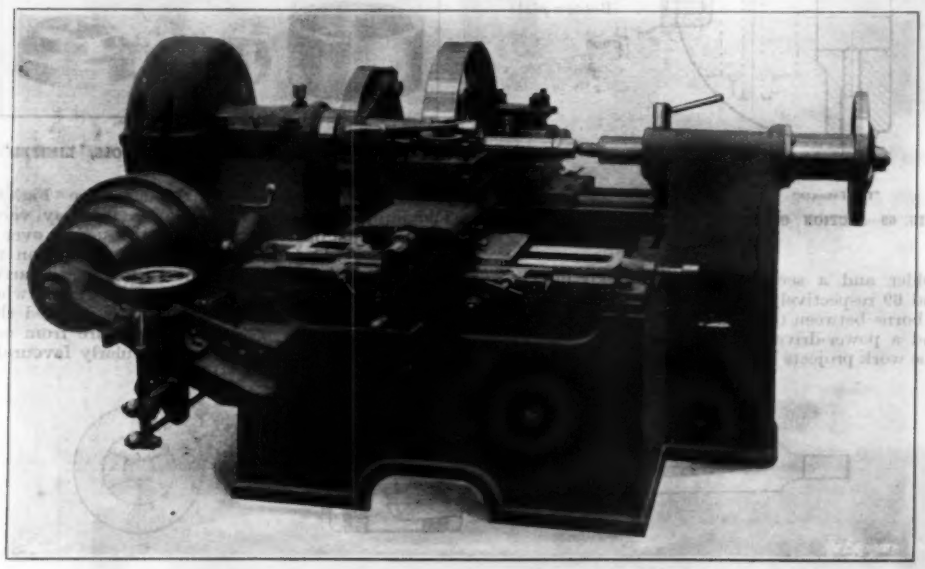


FIG. 73—PULLEY-TURNING LATHE—WARD, HAGGAS AND SMITH

illustrated in Fig. 73, which was shown at the Exhibition by Ward, Haggas and Smith, of Keighley, has been designed to permit the work to be run at high speeds under a feed limited only by the properties of the tool steel used. The headstocks of the machine are cast in one with the bed in order to eliminate vibration. The bed is formed with a solid top on which are mounted two independent cross slides, which can be adjusted separately towards or away from the centre line of the lathe by means of screwed shafts. Each cross slide carries a square turret on a saddle mounted on compound slides. Three rates of feed and a reverse motion are obtainshares of the work. The tension chains referred to also serve to apply the inward feed to the cutters, the power for the purpose being supplied manually through the agency of a long wooden lever, or, alternatively, by means of a worm and worm wheel. The cutter slides are mounted on a head carried on a hollow cast iron spindle, into which the stock passes from a vice and supporting rollers at the front of the machine. At the rear end of the spindle a stop, operated by a foot lever, is provided for controlling the length of stock to be cut off. A series of retaining rings is provided with the machine, one of which, of the size to suit the stock being cut, is screwed into the mouth of the spindle. The part cut off falls inside the spindle behind the ring, and is pushed out by the succeeding parts. Some 3½ to 4 horse-power are consumed in driving the machine. As an example of its performance, the makers tell us that it can cut off a mild steel bar, 3in. in diameter, in 45 seconds, including the time spent in moving up the bar and re-gripping it in the vice.

Messrs. Taylor also exhibited some plugging lathes

FIG. 74—ROTARY CUTTING-OFF MACHINE—C. TAYLOR

for producing steam, gas and water cocks, and some cock-boring machines, designed for producing the taper holes in cock bodies.

The chief novelty on the stand of Thos. Firth and Sons, Limited, Sheffield, was a range of centre drills made of high-speed steel. It has, of course, been urged against the use of high-speed steel for centre drills that in the event of the drill breaking off in the work it could not be softened sufficiently to allow its being drilled out. On the other hand, however, the steel has the advantage that it does not lose its keen edge readily, and consequently does not heat up and bind in the hole. The Firth drills are also provided with a slight back taper to reduce the liability to jam. The makers say that these drills will make as many as 1000 centres in high-speed steel drill blanks without regrinding.

Mr. Alfred Beebee, of Wood-street Works, Wednesbury, had a stand on which there was exhibited a large range of bright bolts and nuts, studs, set pins, &c., ranging in diameter from ¼in. up to 3in., and of various lengths.

ENGINEERING GOLFING SOCIETY.—By the courtesy of the St. George's Hill Golf Club, the autumn meeting of the Engineering Golfing Society will be held on that Club's course on Wednesday, October 15th. The following is the programme for this meeting:—Morning, 18-hole medal round, for the "Hele-Shaw" Scratch Challenge Cup and Memento. Prizes also will be given in this medal round for:—(*a*) The best and second best scores (first division for handicaps of 10 and under, second division for handicaps of 11 and over); and (*b*) the best net scores for each nine holes, Nos. 1–9 and Nos. 10–18 (under half handicap, fractions to count). Afternoon, foursomes. 18-hole match play against bogey. (Three-eighths of aggregate handicap.) For the "Hadfield" Challenge Cups. Mementoes and second prizes will be given. It is hoped to start the competition not later than 10 a.m. Entries close by first post on Thursday, October 9th. The Club House is about a mile from Weybridge Station, and conveyances will be available. Trains leave Waterloo at 9.20 and 10.15 a.m., arriving Weybridge at 10.3 and 10.58 respectively. Further particulars may be obtained on application to the hon. secretary, Mr. G. M. C. Taylor, 36, Victoria-street, Westminster, S.W. 1.

THE SURFACE WATER SUPPLY OF CANADA.—The Dominion Water Power Branch of the Interior Department of Canada has published a new volume of that portion of the series of water resources papers which deals with the surface water supply of Canada. This report is number 40 of the series, and gives details of stream measurements made in the Provinces of Alberta, Saskatchewan, Manitoba and Western Ontario during the climatic year from October 1st, 1921, to September 30th, 1922. The Dominion Water Power Branch of the Department is engaged in making a systematic survey of the water resources of the whole of the Dominion. For convenience in the administration of a survey covering so great an area the country is divided into four major districts, the boundaries of which are arranged to correspond as far as possible with the watersheds dividing the great river systems of the northern part of the Continent, but are necessarily, to some extent, governed by provincial and territorial boundaries. The present report contains a short explanation of the purpose and scope of the work and two hundred and sixty-three pages of tables and descriptions of gauging stations, with an index map of Alberta, Saskatchewan Manitoba and Western Ontario showing their positions. The report will be supplied free of charge on application to the Director of Water Power, Ottawa, Canada.

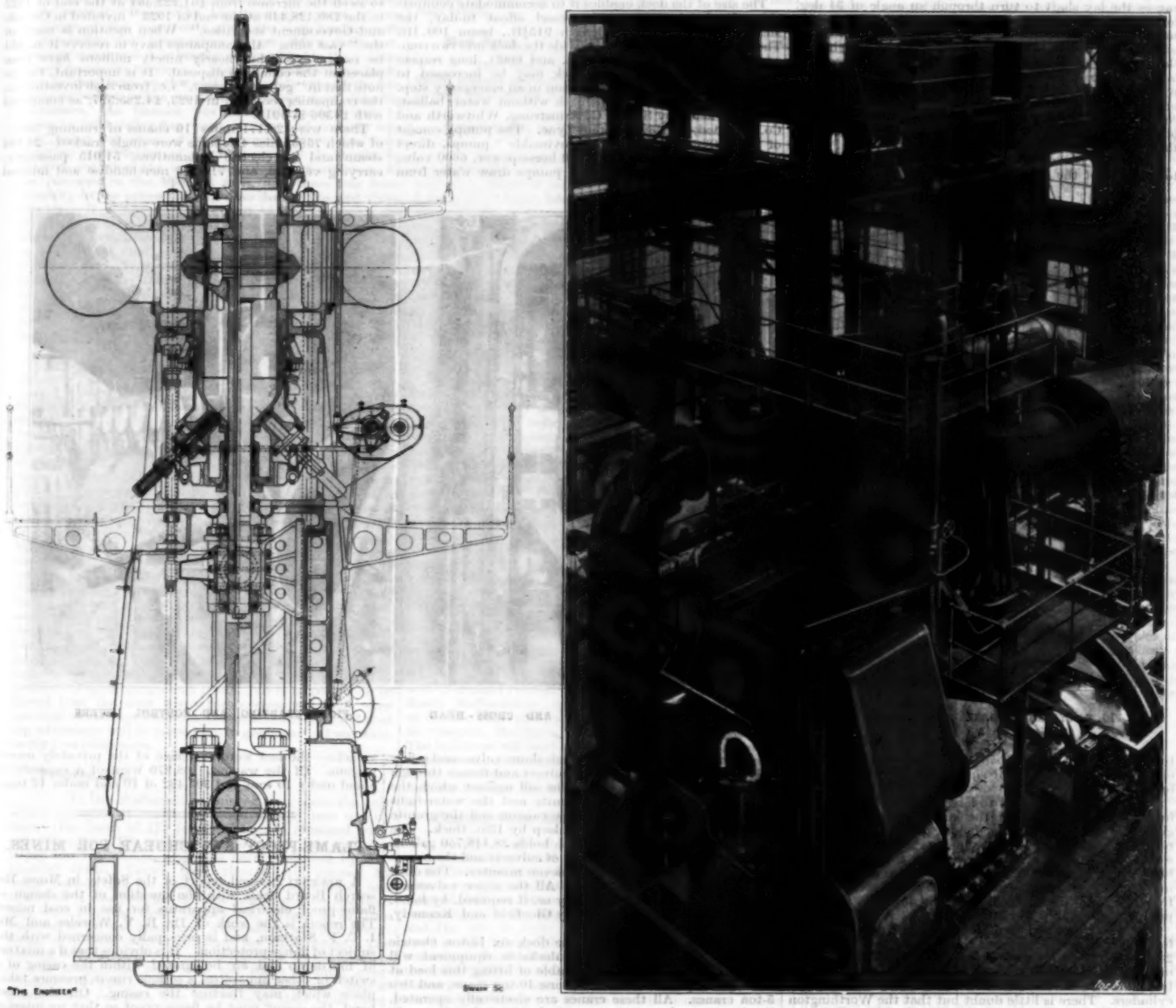
The Worthington Double-acting Marine Oil Engine.

As announced in our last issue, the Worthington Pump and Machinery Corporation, of Snow-Holly Works, Buffalo, New York, has recently designed and built the first unit of a new type of double-acting two-cycle marine oil engine. The engine, we learn, recently underwent successful preliminary trials at the company's Buffalo works, and we are indebted to the associated British firm, the Worthington-Simpson Company, Limited, of London and Newark, for some further particulars concerning it. For many years Worthington gas and oil engines have continued to hold a leading position in the United States, and it is not surprising therefore to learn that in view of the growing importance of the internal combustion engine for marine propulsion, the Worthington Corporation has during the last four years turned its attention more particularly to the marine problem. In the research work which has been carried out, the company has been fortunate in having the assistance of Dr. C. E. Lucke, Professor of Mechanical Engineering at Columbia University, New York, and Mr. O. E. Jorgenson, who, it will be remembered, was well known on the Clyde for the active part he took in introducing the Burmeister and Wain design of marine oil engine to this country.

After carefully considering the merits of the different types of marine oil engine, it was decided to adopt the two-cycle double-acting design of engine. According to the Worthington engineers, if the power developed by a four-cycle single-acting engine of given bore, stroke and piston speed be represented as 100, then the corresponding output for a similar two-cycle single-acting engine operating under the same M.E.P. conditions would be represented by the figure of 156, while the double-acting four-cycle and two-cycle engines would be represented by the figures 190 and 296 respectively. Apart, however, from the gain in power, the design which has been chosen presents considerable advantages as regards the space taken up and also the weight of the engine.

In the accompanying illustrations we reproduce in Fig. 1 a vertical section through the engine, while the engraving, Fig. 2, shows the engine arranged for the trial run on the test bed.

The following are the cylinder dimensions of the new engine :—Diameter of cylinder, 27in.; stroke, 40in. During the trials, when running at a normal speed of 90 revolutions per minute, an output of about 670 brake horse-power was obtained, and this, we learn, was increased to 940 brake horse-power when the speed of the engine was raised to 125 revolutions. At these outputs the engine was conservatively rated, a brake mean effective pressure of from 61 lb. to 63 lb. per square inch being maintained. The cards which were taken during the trials showed, we understand, that more than half of the power by about 5 per cent. was developed on the upper side of the piston, whilst the power contributed by the lower combustion space was under the half by about a similar percentage.



FIGS. 1 AND 2—DOUBLE-ACTING, TWO-CYCLE MARINE OIL ENGINE

Constructional Details.

Several novel features in design are to be noted, all of which we are told are covered by world patents. The main bedplate and the crank case do not call for particular comment, as they follow closely the conventional marine oil engine design. We may remark, however, on the large oil-tight inspection doors on the crank case, which when removed give full access to the crosshead and piston cooling pipe connections. A view of the connecting-rod and crosshead with one of the crank case inspection doors removed is reproduced in Fig. 4.

The crank case itself is divided from the upper part of the engine by a top partition plate, in which is fixed a stuffing-box and scraping ring attachment. The object of the stuffing-box is to prevent the products of combustion from entering the crank chamber, while the scraping ring prevents oil being carried from the crank case into the lower cylinder space. On the top of the crank case is mounted an extension piece, which, in turn, carries the cylinder base proper. A more detailed view of this part of the engine is given in Fig. 3, which shows the extension piece and cylinder base with the lower cylinder in position for purpose of undergoing the water pressure test. This view, taken in conjunction with the drawing, Fig. 1, will make clear those features of the design which have permitted the usual type of cylinder cover to be done away with.

The cylinder base, it will be seen, is of rectangular box form. It is provided with the necessary scavenging air and exhaust ports, and is bored out top and bottom to receive the cylinder liners. By means of four steel bolts, which are carried right through to the bottom of the bedplate, the base is secured in such a way that it is relieved of all tensional stress.

The liners, both top and bottom, are made in two parts. The inner liner is made of cast iron and carries the exhaust and scavenge air ports, and this part is pressed into an outer or main liner, which is of a domed shape, and is machined from a mild steel forging. In the case of the top liner there is a central aperture, which carries the fuel valve seating, whilst in the case of the lower liner provision is made for the stuffing-box connection and for two fuel valves placed symmetrically at an angle of a little over 45 deg. to the centre axis. Both the outer liners are flanged and are held in position by clamping rings secured to the cylinder base by studs. The rings also serve to hold and to tighten light cast iron jackets, placed over the outer liners with gland rings, which enclose the liner cooling water spaces. The ends of the inner liners rest on a central flange in the cylinder base, which serves to guide them in such a manner that good cylinder alignment is given.

It will be seen that the top and bottom ends of the cylinder really comprise, so far as expansion and the heat problem is concerned, two quite independent single-acting cylinders. The cooling water for the cylinders enters the cylinder base at the middle part and moves in an upward direction through the top cylinder jacket, and at the same time downward through the bottom cylinder jacket. The flow is regulated by outlet valves on each jacket. Fresh water is used in preference to salt water for cooling both cylinder liners and the main piston. Fig. 4 shows the telescopic pipes and piston cooling water connections on the main crosshead.

The piston itself is formed by two single-acting pistons, each of which rests on a central flange provided on the piston-rod, to which they are secured by bolts. The centre portion of the piston is a sleeve made in halves, which is secured in such a way as to allow each end of the piston to expand. Piston heads of forged steel are employed, and the ends are shaped to allow an easy flow of gases to the exhaust ports and to give an upward deflection to the scavenging air.

Valves and Manœuvring Gear.

Air injection is used for the fuel valves, which are neatly operated from a horizontal cam shaft at platform level by push rods. In the top fuel valve, pulverising cones of the ordinary type are used, but the flame plate is of conical shape, and is furnished with four orifices. The

two fuel valves for the lower cylinder space differ somewhat from the upper valve. A pulveriser of the hollow perforated sleeve type is employed, and each of the flame plates is provided with two orifices, which direct the oil spray tangentially into the space between the piston-rod and the cylinder wall. The fuel pump is placed at bottom platform level near the fly-wheel end of the engine, and is furnished with an over-speed governor. Each fuel valve has its own fuel cam, which is supported on a fulcrum shaft. By slightly displacing the fulcrum shaft centre with a small hand control lever, a variable lift for slow running is obtained. The manœuvring gear is novel in design and very simple, in that only one lever is employed for reversing the engine.

All the cams are symmetrical, and they are placed in the correct ahead or astern position by rotating them through an angle of 34 deg. in relation to the crank shaft. This operation is accomplished in the following way:—A spur gear fixed to the main crank shaft engages with an idle wheel which, in turn, drives a further spur wheel keyed to a horizontal lay shaft in the bed-plate at the front of the engine. The shaft is supported in bearings in such a way that it can slide a given amount longitudinally. As all the gears referred to are helical gears, the rotary motion causes the lay shaft to turn through an angle of 34 deg. for the full distance of travel from one extreme position to the other. At the forward end of the shaft there is an oil-operated piston moving in a cylinder and attached to the shaft by a ball-bearing connection, which allows the lay shaft to revolve, but determines its longitudinal position. By admitting oil under pressure to either one or the other side of the piston, the lay shaft takes up the correct position for ahead or astern running, and as the power is transmitted to the cam shaft by bevel gearing, the cams on the shaft are automatically set.

The engine is reversed by admitting oil under pressure to one side of the operating piston, and allowing the oil to escape from the other side. This operation is carried out by a four-way cock of simple design, which is hand operated.

The valve gear is stated to have proved very successful in operation. A view of the engine control station is given in Fig. 5. The scavenging air may be supplied by a reciprocating scavenge pump, such as is used on the unit we are describing, or for large engines a separate turbo-blower may be installed. It is the intention of the Worthington Corporation to drive the necessary service pump from the main engine, and so to cut down the auxiliary pumping machinery to the minimum.

The unit described forms one cylinder of a projected four-cylinder engine, which is to be designed to give about 2400 shaft horse-power when running at a normal speed of 90 revolutions per minute. Engines, we learn, are to be built in standard units of from three up to eight cylinders. There is little doubt but that the Worthington engine will play an important part in the conversion programme of the United States Shipping Board. The calculations as to weights and costs are, we learn, such as to indicate a substantial saving as compared with other types of marine oil engine of similar power and rating. As regards scantlings and overall dimensions, the design has been prepared in such a way that the engine can take the place of reciprocating steam engines or turbine machinery without making extensive hull alterations.

Negotiations are already in progress with a view to granting a licence for the Worthington engine to a large American shipyard. As regards our own country, it will be remembered that the rights of the Worthington Pump and Machinery Corporation of New York are represented in Great Britain and throughout the British Empire by the Worthington-Simpson Company, Limited, of Queen's House, Kingsway, which has its works at Newark-on-Trent. The engine we have described may, we are advised, be built at Newark, and, in addition to this, negotiations are in progress in the matter of granting building licences to certain shipbuilding firms in this country.

On the London and North-Western section of the London, Midland and Scottish Railway there are now 457 track circuits, equal to an approximate continuous length of 62¼ miles.

New Graving Dock at Durban.

The new graving dock which is being built at the Port of Durban (Natal) is expected to be completed towards the end of this year. It is being constructed entirely departmentally by the South African Railways and Harbours under the direction of Mr. W. R. Crabtree, M. Inst. C.E. It is on the most up-to-date lines and has the following dimensions, which place it as one of the three largest graving docks in the world, the other two being at Victoria (B.C.) and Quebec, each being the same length, but 25ft. and 10ft. wider respectively:—

Total length	1150ft.
Width at entrance	110ft.
Width at coping	138ft. 6in.
Width at floor	110ft.
Depth on sill at H.W.O.S.T.	41ft.
Depth on sill at L.W.O.S.T.	35ft.
Spring tide rise	6ft.
Coping above L.W.O.S.T.	12ft.
Floor of outer end (below L.W.O.S.T.)	40ft.
Rise of floor	1 in 660

The size of the dock enables it to accommodate comfortably the largest mercantile vessel afloat to-day, the Majestic, of 56,551 tons, length 915¼ft., beam 100.1ft. There are two caissons, which divide the dock into two compartments, approximately 440ft. and 660ft. long respectively. The length of the dock may be increased to 1191ft. by placing the outer caisson in an emergency stop. The caissons weigh 875 tons each without water ballast, and were made by Sir W. G. Armstrong, Whitworth and Co., Limited, at Newcastle-on-Tyne. The pumps consist of three 48in. twin parallel "Invincible" pumps, direct coupled to electric motors of 760 horse-power, 6600 volts, three-phase, 50 periods. These pumps draw water from the main sump and deliver through sluice valves and reflux valves into the main discharge culvert and thence through the return wall to the bay. The sill against which the caisson bears is formed of granite and the water-tight medium between the steel of the caisson and the granite sill is greenheart timber 15¾in. deep by 12in. thick. The process of filling the dock, which holds 38,118,750 gallons of water, is effected by a system of culverts and the operation is calculated to take forty-seven minutes. The dock can be emptied in four hours. All the sluice valves are operated by electrical machinery or, if required, by hand. They are all being supplied by Glenfield and Kennedy, Limited, of Kilmarnock.

For warping a vessel into the dock six 15-ton electric capstans are provided. The dockside equipment will consist of one 25-ton crane capable of lifting this load at 90ft. radius (10 tons at 100ft.), one 10-ton crane, and two 5-ton cranes. All these cranes are electrically operated. Fresh water, salt water, compressed air and electric supply services are available with suitable devices for tapping. In the case of compressed air a 4in. main is laid along the dock length at the side at floor level and is provided with valves at convenient points.

It may be added that Durban Harbour at the present time can accommodate forty-seven ships of an average length of 480ft., viz., twenty-eight at berthage and nineteen at the moorings. With two abreast alongside the berthage a total of seventy-five ships can find refuge inside, and by the time the additional deep-water berthages are completed and the Maydon Wharf, at present in course of construction, is extended to the graving dock, accommodation will be available for ninety ships.

The harbour is open to ships all the year round. Up to the present no vessel of a greater depth than 33ft. has entered it.

THE RAILWAY RETURNS FOR 1923.

From the Stationery Office publication, "Returns of the Capital, Traffic, Receipts and Working Expenditure of the Railway Companies of Great Britain for the Year 1923," we learn that during that year the railways of Great Britain spent £24,990,483 (£11,877,578) on maintenance and renewal of way and works; £12,652,632 (£6,062,388) on the maintenance and renewal of locomotives; £7,945,489 (£3,647,635) on carriages; and £8,080,337 (£3,619,553) on wagons. The cost of locomotive running was £40,815,155 (£17,239,375), of which £20,742,041 (£6,024,336) was for enginemen's wages, £15,440,119 (£8,509,005) for coal, £884,448 (£521,666) for water, and £440,111 (£258,685) for lubricants. The figures in brackets are those for 1913.

As the amount of the railway companies' reserves is a subject often discussed, it may be noted that the depreciation fund for railways totalled £67,953,603 at the end of 1923 and £8,048,352 for steamboats. At the end of 1913 these figures stood at £8,983,443 and £3,391,284 respectively. This increase is due to the sums paid by the Government during the control period for maintenance and renewal, which, owing to the scarcity of labour and material, could not be spent on the track and rolling stock. Assuming that the pre-war standard of maintenance has again been reached, these sums will no longer be required for the purpose for which they were allotted. Of the sixty millions voted to the companies under the Railways Act, 1921, in settlement of all claims, there remained £13,007,888. This sum was £34,538,873 less than in 1922. Probably a goodly proportion of the latter amount went to swell the increase from £61,222,364 at the end of 1922 to the £89,428,446 at the end of 1923 "invested in Consols and Government securities." When mention is made of the "vast sums" the companies have in reserve it should be remembered that nearly ninety millions have been placed at the country's disposal. It is important, too, to note that in "general interest," *i.e.*, from such investments, the companies received, in 1923, £4,285,397, as compared with £4306 in 1913.

There were 20,171 miles 16 chains of running line—of which 7586 miles 42 chains were single tracked—24,184 steam and 41 electric locomotives, 51,015 passenger-carrying vehicles, and 714,246 merchandise and mineral vehicles—the last were exclusive of the privately owned wagons. Of the wagons, 168,976 were of a capacity of 8 and under 10 tons and 303,432 of 10 and under 12 tons.

FIG. 3—CYLINDER BASE AND BOTTOM CYLINDER

FIG. 4—CONNECTING ROD AND CROSS-HEAD

FIG. 5—STARTING AND CONTROL LEVERS

FLAME-PROOF SWITCHGEAR FOR MINES.

A recently issued report of the Safety in Mines Research Board deals with the question of the design of flame-proof electrical apparatus for use in coal mines. The report is the work of Dr. R. V. Wheeler and Mr. I. C. F. Statham, and is principally concerned with the subject of flange protection. It is obvious that if a mixture of fire damp and air be ignited within the casing of a switch or other apparatus, a serious rise in pressure takes place which may fracture the casing. On the other hand, the casing must be flame-proof so that no internal explosion can set up an explosion of fire-damp or coal dust in the atmosphere which surrounds the apparatus. One method employed is that of leaving a small gap at the flanged joints of the casing, which, while narrow enough to be flame-proof, is yet wide enough to allow a release of pressure to take place. The report we refer to contains the results of a large number of experiments made with such apparatus. Conclusions have been drawn from the experiments regarding the width and type of joint gap and the breadth of the flanges in relation to a given volume of casing. The experimenters draw the general conclusion that, provided careful attention is given to the design and method of assembling the casings, "flange protection" can be relied upon to overcome the difficulties presented. The report is published by His Majesty's Stationery Office.

The frames and bogies of all passenger-carrying vehicles on the London, Midland and Scottish Railway are, in future, to be of steel and the body framing of jarrah non-inflammable timber. The company is considering the use of steel panelling for the front and sides of motor vehicles of electrically-operated trains, and steel side panels instead of mahogany are being fitted to a number of the kitchen cars and steam-worked trains.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

An Important Price Concession.

A price concession which is of great importance to the Midland iron trade and which should aid materially in the recovery of the trade, is that decided upon by the cokemakers last week. The basis for blast-furnace coke to associated blast-furnaces in the Midlands from October till the end of the year is to be 16s. 9d. per ton at ovens, as compared with 20s. 6d. during the past three months. The claim of the smelters for relief was irresistible in view of the changed outlook for the cokeries, but the reduction, conceded after protracted negotiation between the representatives of the blast-furnaces and the ovenmen, is larger than had been generally anticipated. Indeed, in some quarters it was hailed as an "unexpectedly bold and generous measure," and it is hoped it may prove the turning point introducing the much desired trade revival. Dear coke has been the most serious handicap of the iron trade since the war, having made it impossible for ironmasters to get down their production costs, and it is largely responsible for the putting out of numerous furnaces. The coke makers have lately been holding large stocks, and have sorely missed the idle furnaces, which, when at work, are their most valuable customers. As furnace has followed furnace out of action, a bold policy has been chosen, and possibly this may bring out some of the business which has been awaiting stabilisation of pig iron prices. It should be pointed out that the association does not embrace all the furnaces in the Midland area, and there has been diversity in the prices paid for coke during the past three months. It is not quite clear yet to what extent coke prices on the open market will conform to those which took effect on Wednesday under the scale. Further, it should be understood that the coke priced at 16s. 9d. is the lowest grade. The average Midland smelter will want something better. He would regard it as false economy to buy such an inferior quality. However, the fact remains that blast-furnacemen in the Midland area are now to get the substantial relief in coke charges for which they have waited so long.

Effect on Pig Iron Prices.

Interest in the market this week centred chiefly in the pig iron department, and the effect which the reduction of 3s. 9d. per ton in the basis price of coke would have on raw iron values. Consumers of pig iron expected to get a share of the concession, and the course of the market strengthens the belief that they will eventually succeed. Even with so few furnaces in commission there is more pig iron being offered than consumptive demand will absorb. The finished trade has deteriorated and consumers of pig iron will certainly continue to press for further price concessions from the smelters. Makers of iron contend that the coke price concession has already been discounted, and undoubtedly price cutting has been keen. But it is well known that the cheaper coke will effect a saving of 5s. to 6s. per ton, and the equally hard pressed maker of finished material wants some of the relief conceded by the coke maker. Up to the time of writing the market threw no light on this point. Some smelters declined to quote at all; others stood by last week's quotations. Furnacemen maintain that the reduction is insufficient even to wipe out the loss they are making on present prices, but it is greatly to be feared that the time when furnacemen will gain some material advantage from cheaper coke is not yet, and that the advantage will be passed on, in great part, at any rate, to pig iron consumers.

Finished Iron.

In the Staffordshire finished iron trade the only active department continues to be that of best quality bars. The basis of £15 for these bars is obtained without difficulty. The makers in this branch are comparatively few in number, and it is hardly affected by continental trade. Crown bars, though still quoted by many makers £13 per ton, continue to deteriorate, and this week it was possible to place orders at even less than last week's lowest figure of £12 15s. There is so little business to be had that some ironmasters sacrifice everything to obtain orders and keep the mills going. The fencing and nut and bolt trades are getting very few orders of any magnitude, and, with the Black Country overstocked with cheap bars imported from Belgium, district producers of common bars are running their mills intermittently on such odd orders for special sizes as come along. Quotations are maintained at £12 per ton. Belgian prices continue to deteriorate, and this week bars have been offered at £8 2s. 6d. delivered in the Midlands.

Galvanised Sheets.

Contracts for galvanised sheets are not quite so plentiful as they were, but the works are in a good position, though prices have eased a little to £18 up to £18 5s. f.o.b. for export, and at works for home consumption. The tin-plate trade is busy, and there is no difficulty in getting the full price of £1 3s. 6d. per box.

Steel.

In the steel trade the mills are getting a few more orders, and an increase in constructional business gives some promise of still more activity within a few weeks. The volume of inquiry for this class of steel has increased materially during the past week, and engineers are busy sending out tenders. It is assumed that a fair proportion of these will eventually lead to business and increase the amount of work in hand. Unfortunately shipbuilding orders are still scarce. The rolling lists supplied from the mills show a miscellaneous output, preventing the large production so essential to profitable manufacture. In view of the rail orders given abroad by some municipalities the declaration made some days ago by the London, Midland, and Scottish Railway Company that it does not intend to purchase abroad is timely and welcome. It will be remembered that some time ago the same company warned its re-rolling suppliers that steel made from foreign semi-finished material would not be accepted. It is hoped that other railways will follow this example. It should be noted that the general policy as to rolling stock is to purchase British vehicles, and the Birmingham firms are provided with very good order books for home and foreign railways, ensuring regular operations for some time to come. Competition in the steel market is very keen. Manufacturers of finished material are driven to seek supplies of raw material where they can buy them cheapest, and this means that semis are being brought in from the Continent without cessation. Foreign billets are on offer this week at prices ranging from £6 to £6 10s. Large stocks of these foreign billets are still held by Midland consumers, so that at present there is very little disposition to buy forward native material. In most departments of the trade home makers are unable, owing to the high cost of production, to bring their prices near to those of the continental shippers. In spite of this keen competition native steel masters adhere to their minimum quotation of £7 10s. for mild steel billets.

Steel Scrap.

Steel scrap continues weak at £3 10s., but at this figure makers are not keen for business, many preferring to hold their stocks in the hope of better prices.

Improvement in Pipe Founding Trade.

It gives me pleasure to be able, in these times of poor business, to record an improvement in one of the important Midland industries. The pipe founding trade, I am glad to state, has become much busier. Orders for 3in. and 4in. pipe are so plentiful that some of these contracts will, it is understood, run into the spring of next year. A proportion of the business recently negotiated is concrete lined, this material being popular with some engineers, who prefer to keep the metal from contact with the water. It is significant that many iron pipe casting firms in the district are increasing their plant to cope with a demand which is growing and promises still further expansion.

Tube Trade.

Another industry in which a welcome revival has taken place is the tube trade. Black Country works are now generally making very good time, and in a few cases overtime is being worked. The tube mills handling welded tubes, whether of iron or steel, are busier than they have been for some time. To some extent this is a seasonable recovery, for in the autumn pipe lines have to be restored and extended, but the activity is better than usual. Moreover, there is a good share of foreign business, especially satisfactory to manufacturers, in view of the keen competition normally met with from abroad. This improvement in tube business is of considerable importance to this district, for it entails an increased call for gas strip. The Staffordshire ironworks usually furnish the necessary strip, either in wrought iron or re-rolled steel for the tube mills. Prices of wrought iron gas strip have been firm for some time on the £13 5s. basis.

Government Order for Tipton.

A contract has been placed by the Air Ministry with Nortons (Tividale), Limited, Hecla Works, Tipton, South Staffordshire, for the manufacture and erection of the six large aeroplane sheds, which are being erected at Gosport, Rainham, North Weald and Martlesham. The buildings will have steel and asbestos roofing, and the approximate area of roof in each shed will be 34,000 square feet. Satisfaction is expressed in South Staffordshire that the contract has been secured for this district.

Cannock Chase Miners' Wages.

The wages of the miners in the Cannock Chase area are to be reduced again during October, the extent of the decrease being 7.75 per cent. on the wages basis. This is equal to a reduction of 6d. per day on the minimum wage of stallmen, whose rate of pay will be 10s. per day, compared with 10s. 6d. in September, 11s. 1d. in August, and 11s. 10d. in July. Lower-paid mine workers, however, as the result of the recent conference between representatives of the Cannock Chase Miners' Association and the local Coalowners' Association with regard to a readjustment of the wage basis of the lower-paid day wage men and youths, are to receive certain increases. Underground men will get 3d. per shift more, and the boys from 3d. to 6d. per shift. On the surface, youths over 17 will receive increases varying from 2d. to 6d. per shift. The request for an increase for boys between 14 and 17 has not been granted. The wages of banksmen and pushers-on will be increased by sums varying between 1d. and 1s. 6d.

Coal Seams in North Staffordshire.

It is reported that eight seams of coal have been found under a 258-acre farm in the neighbourhood of Biddulph and Congleton, North Staffordshire. Experts declare that there are millions of tons of coal and other minerals under the soil in the districts of Sandbach, Congleton, Biddulph, and other centres.

Further Improvement in Unemployment.

Three weeks ago the total number of persons unemployed in the Midlands was 150,344. Last week the returns showed a decrease for the period ended September 15th to 149,893. The latest returns, made up to September 22nd, show a further reduction to 148,521. In the Birmingham area the total now is 38,737, as compared with 38,954 and 38,673 in the two previous returns. In Coventry there are ten more unemployed than there were in the previous return.

LANCASHIRE.

(From our own Correspondents.)

Manchester.

General Outlook.

There is no sign of improvement yet in the iron and metal markets here, and, if anything, general business seems to be rather quieter than it was. It seems now to be very generally recognised that the costs of manufacture are too high all round; but no one has any definite idea as to how they ought to be brought down. Of course, a simple way would be to return to longer hours, and some statistics have been published about the effect of this upon costs in foreign countries; but it is almost hopeless to expect that any such return is possible here. Meantime, of course, trade is being lost, and it is difficult to see how the tendency is to be arrested. Dear fuel and a short working day are at the bottom of much of our industrial troubles; and, of course, dear fuel is one of the results of a short working day. The reduction of furnace coke prices last week in the Midlands was one step towards a return to more reasonable prices, but we want all fuel prices reduced to the same extent.

Metals.

The markets for copper and its alloys do not show very much movement. It is fairly certain that the expectation that Germany would at once become a large buyer of copper was, to say the least of it, premature. It is now more clearly realised that the recovery of industrial Europe is a slow process, and its effect on the markets may not be visible. Consumers of copper here show no fear of any probable advance, and continue to buy in small quantities and for prompt needs. There would seem to be no disposition on the part of consumers to secure large stocks of copper, although no one believes that prices can be much lower than they are. In fact, it is fairly certain that if prices moved downward only a little, many merchants would be inclined to speculate for a rise. The reports from America have not been very optimistic of late, and one cannot find any evidence that large autumn buying is beginning on that side; but there is some apprehension that the American output of copper is increasing again. Costs of producing copper vary enormously in America, some companies being able to make refined copper at a cost which bears a big profit even at present prices; and these companies naturally do not want to have their output restricted. With regard to manufactured copper and brass, the general run of prices is still inconveniently high, and adds to the difficulties of manufacturing engineers when competing for export orders. Twice, however, quite recently, copper sheets have been reduced by £1 per ton without much corresponding change in refined copper. What the consumer wants to see, however, is the restoration of the old relationships between standard copper and manufactured copper and brass, and also the abolition of large differences between home and export prices. Tin has shown some resistance to the "bear" tactics of the last fortnight; but it is still uncertain whether the market can be sustained. The speculative attack on the market succeeded very well, and it is possible that "bear" speculators will now be satisfied, for if they continue the attempt to force prices down it is quite possible that they may meet with disaster. The markets for lead and spelter are quiet and steady. The movements in lead are not nearly so large as they were, and perhaps the market is arriving at a more stable position. The recent slight weakness in spelter prices seems to be a reflection from the American market, where some uneasiness prevails.

Pig Iron.

The reduction in the price of Midland coke, which was announced towards the end of last week, has thrown the market here into some confusion; not that some reduction has been anticipated for the last few weeks, but that it is much greater than was expected. Makers of pig iron in Derbyshire and the Midlands generally have contended that the recent lower prices were all anticipatory of a fall in furnace coke, and the question now is whether or not any of this fall in costs of production shall be passed on to the consumer. The lesser cost of pig iron manufacture is about 5s. 6d. per ton, and it is natural that the ironfounder in Manchester should expect a part of it, even if he cannot look for the whole. It seems probable that the price of No. 3 foundry iron in Manchester may be reduced to 90s. delivered, or perhaps to a little less. Before the announcement of the cut, No. 3 Derbyshire foundry iron had been sold at 84s. on trucks, or roughly at 91s. 6d. delivered here, so that 90s. would now give the consumer only a small part of the reduction in costs. It would no doubt take a few days to get prices into a fairly regular condition here; but apart from any startling improvement in the demand, there cannot be very much doubt of the ultimate result. It was generally believed that the ironfounders of the district would buy fairly freely over the remainder of the year if 90s. delivered were the established price; but, of course, the reduction in coke being much greater than was expected may induce them to wait still longer, in the hope of lower prices. Cleveland and Scotch irons have both been rather weak, but, of course, they are not directly affected by the Midland coke position.

Steel.

The general condition in the markets for manufactured steel is not greatly affected. Prices for British steel seem to be about at the bottom, irrespective of any small changes in pig iron or in fuel; but the danger to the British trade seems to be growing rapidly from increased foreign competition. Cheap foreign plates are displacing orders for British plates in Scotland, and the difference in price, delivered there, is about £2 per ton. Here the nominal prices remain at £9 7s. 6d. for angles and joists, £10 2s. 6d. for plates, £10 for flat bars, and £10 5s. to £10 10s. for round bars; with continental material at from £2 to £2 10s. per ton less.

Scrap.

The extreme dullness in the markets for scrap material is unrelieved. For ordinary melting steel scrap there seems to be no demand, and the nominal value on trucks at a Lancashire station is about 60s. per ton. There is a little business occasionally in heavy wrought scrap at 87s. 6d. per ton delivered to the forges, and iron-founders buy a little cast scrap; but the latter is weak on the prospect of lower prices for pig iron. Good cast scrap can be had easily now at 85s. per ton.

Rustless Iron.

I had an opportunity recently of examining a number of articles made of rustless iron produced by the Hamilton-Evans process. The articles included domestic appliances, such as pans, door fittings, coat hooks, together with bolts and nuts, wire and thin sheeting, and were sufficient to impress me with the great possibilities which this rustless metal has in front of it. It machines well, and is capable of taking a very high finish. Very briefly, the process of making the iron, which is being exploited by the Stainless Iron and Alloys Company, Limited, 14A, Blackfriars-street, Manchester, consists in introducing chromium ore, together with ferro-silicon, into a slag of suitable composition, mass and temperature on the top of the molten iron in the furnace, when the entire body of ore, with all its fusible components, is fused. The inventors claim that chromium oxide, iron and manganese oxides are reduced, and the chromium and other metals so formed descend into the molten metal, while the other components of the ore are retained by the slag. If it is possible to produce castings of this metal at prices at all comparable with those of ordinary iron, there should be a very wide field for its use.

Manchester Association of Engineers.

The opening meeting of the session of the Manchester Association of Engineers will be held at the Engineers' Club, Albert-square, Manchester, on October 10th, when Mr. Herbert Bates, M.I. Mech. E., will deliver his inaugural address. The syllabus for the session is not yet quite complete, but arrangements have been made for papers on subjects that are well to the front at the present time, including pulverised fuel, hydro-electric power stations, costing and works accounting, and the inner structure of metals. The session will conclude with the report of the Lathe Tools Committee on Cutting Experiments on Cast Iron. All the meetings will in future be held in the Joule Room of the Engineers' Club, a change in the venue which the members of the Association will not fail to appreciate. On Saturday last about 160 members, with the President, paid a visit of inspection to the Barton power station, over which they were conducted by Mr. Pearce's staff. Mr. Pearce was unfortunately unable to be present, as he is now on a business trip to Australia. After the visit the members were entertained to tea by the Manchester Electricity Committee, and a vote of thanks to the Committee was proposed by the President, Mr. Bates.

BARROW-IN-FURNESS.

A Quiet Market.

The hematite pig iron market is very quiet, and although there has been a fall in price, better trade has not followed. There is an absence of orders for forward delivery, and business is just hand to mouth. The fact that the steel trade is in such a bad way leaves some makers of iron with much to put into stock, and unless either the steel departments get to work or the demand for iron improves, there will probably have to be some restriction of output. The demand for special qualities of iron is very poor. Generally speaking, trade is lifeless, and there are no signs of any improvement at present. The continental trade is very quiet, and that with America not worth mentioning. The charcoal furnace at Backbarrow—the only one in the country—is still at work, and is experiencing a fair trade. Shipments of iron have been quiet.

Iron Ore.

The iron ore trade in this district is on a par with the iron trade, as its activities are largely dictated by the condition of iron markets. There is a certain quantity of ore going out of the district, but it is small. None of the mines are at all busy, and some are in a very quiet way. The Cumberland mines are raising the most. Foreign ore is being bought in limited quantities, and there are regular shipments from Spain, but only on a moderate scale.

Steel.

The rail mills are still idle, and although it is hoped to secure some orders to get them restarted, those orders are hard to secure at present, when there are not many in the market, and when competition is so very keen. The hoop and small section mills have orders which will enable them to keep going, and these departments are better circumstanced than any others. Foundries are just moderately employed, and the outlook is not of the best.

SHEFFIELD.

(From our own Correspondent.)

105,000 Tons of Steel Lost.

THE condition of the heavy steel trade continues as unsatisfactory as ever. The strike at three of the largest works in the district is still in progress, and shows no sign of ending. The question of the strikers' eligibility for unemployment pay has now been decided by the umpire under the National Insurance Acts, who has to a large extent reversed the judgment of the local board of referees on the matter, and has found that only about half of the men are entitled to the "dole." The strike has now lasted six weeks, and it is estimated that it has resulted in a loss of at least 105,000 tons of steel output, and of £84,000 in wages to the men. Some very strong remarks with regard to the strike have been made by Mr. T. W. Casey, himself a local Labour leader and formerly a Member of Parliament for the Attercliffe Division. Referring to an offer made by the firms, he said that, whatever its merits or otherwise, it could have been secured without the stoppage of a single hour. He declared that the leadership of the men in the dispute had reached to the very depths of folly.

The Heavy Trades.

The stoppage of these three great works has not even the redeeming feature of causing any appreciably increased demand for the products of those establishments which are continuing at work. On the contrary, the heavy steel trade generally is in a very depressed state, and the same is true of pig iron. This is particularly the case in North Lincolnshire, where until recently activity was very good. The Redbourne Hill steel works had to close a few weeks ago; last week the North Lincs. Iron Company, Limited, damped down the only two furnaces it had in blast; further, the Trent Iron Company, Limited, a subsidiary of John Brown and Co., Limited, of Sheffield, announces that owing to serious depression in the iron trade it may be compelled to close its works. The men employed at the blast-furnaces and ironstone mines have been put on a week's notice, terminating on October 3rd, and in the event of work being carried on after that date the condition of employment will be from day to day. A brighter report comes from the Frodingham Iron and Steel Works at Scunthorpe, which, in the week before last, achieved a record output of 6193 tons of steel from six furnaces, two of which are of small size. The Frodingham Iron and Steel Company is a branch of the United Steel Companies, two of whose other establishments—Steel, Peech and Tozer and Samuel Fox and Co.—are closed down owing to the Sheffield strike.

The Finished Trades.

The trade situation locally has developed another unsatisfactory feature in the position of the lighter and finished branches of steel production. For some weeks past I have been able to write favourably of the progress of several of these branches, but now a turn in the other direction is reported. The rolling mills state that there is a distinct reduction in the receipt of work, especially in the bar section. The sheet mills, which form a useful criterion of the state of the lighter trades, are working fairly well, but they find that less forward business is coming to hand, and that the outlook is not by any means as good as it has been. The falling off relates to both the home and export trade. The trade in best tool steels has suffered a setback. It had been showing signs of recovering from the depression in which it has been plunged for some years, but the present position is discouraging, and it can only be hoped that it is but of a temporary character. A good demand has been experienced throughout the year for shovels, spades, picks and various excavating and contractors' tools, but the trade is now tapering off somewhat. Quarry and edge tools are in a similar position. The improvement in the call for engineers' small tools appears to have sustained a check. There is still much activity in the trades making saws and builders' tools, but the pressure for supplies is not so strong as it has been. The great wire rod mill at Templeborough has had to cease work, owing to the exhaustion of raw material due to the strike. The wire trade, although still well employed, is not up to its recent standard of briskness, while in the section for finished wire goods things are very quiet.

A Drop in Coke Prices.

Hopes of an improvement in the pig iron trade are encouraged by the fact that a substantial reduction in the price of coke has been arranged. At a conference in Sheffield last week, between coke makers and blast-furnacemen, the position was reviewed, and it was decided to reduce the basis price of furnace coke from 20s. 6d. per ton to 16s. 9d. This figure represents the minimum, and values will be scaled according to the calorific values of the fuel, in accordance with the system which has already been in operation for three months. The pig iron industry has for some time been working on an unremunerative basis, and this concession should be of substantial assistance to it. Prices of steel scrap are at present very low, but trade is only on a moderate scale, in view of the poor demand for pig iron and steel. The price of heavy steel scrap delivered to the works for basic furnaces is now between 80s. and 82s. 6d. per ton, while similar scrap suitable for electric furnaces fetches up to 92s. 6d. Low sulphur and phosphorus acid steel scrap is £5 5s. per ton delivered, turnings for electric furnaces 70s., turnings for basic steel furnaces 67s. 6d. delivered works, heavy wrought iron scrap 95s. delivered. Machinery cast iron scrap for the foundry is quoted at 95s. to 97s. 6d. per ton, delivered West Riding and Lancashire stations.

Cutlery and Plate.

There is not much change to report in the cutlery and plate trades. The stainless table knife department is still the busiest in the cutlery trade. For pen and pocket knives the demand shows some improvement, but activity is not on a satisfactory scale. The safety razor blade trade of Sheffield continues to make good progress, not only at home, but in several overseas markets, notably Canada and France. The export returns show a considerable improvement. These give a combined figure for both safety razors and their blades, but comparatively few of the former are shipped, so that the return may be taken as referring mainly to blades. The quantity of these exported in August was 37,661 dozens, as compared with only 5825 dozens in August last year. In the eight months of the year the total was 252,845 dozens, as against 113,814 dozens up to August, 1923. The export of ordinary razors in August this year was 3291 dozens, of which more than half went to Australia. The total for the eight months is 26,564 dozens, as against 16,572 dozens last year. In the electro-plate trade the only really active section is that of spoons and forks. There is a poor demand for hollow-ware, whether of nickel silver, Britannia metal or sterling silver. Large quantities of cheap machine-made goods are being put on the market by Birmingham, and Sheffield is losing trade in consequence of this competition.

A Malleable Rustless Steel.

Since the introduction of stainless steel, many attempts have been made to produce this material in a malleable form, suitable for cold-pressing without further treatment. This result has now been achieved by Thomas Firth and Sons, Limited, of Sheffield, who have produced a material which is likely greatly to extend the already considerable field covered by stainless steel. The material is not intended to take the place of stainless steel in its hardened or hardened and tempered forms, but to replace that class of material to which the name of "stainless iron" has been applied. Whereas considerable strength and the capacity for being hardened have been recognised as essential properties possessed by stainless steel, the new steel, which is not intended to be hardened, has a low yield-point of only 12 to 15 tons per square inch and an elongation of 55 to 70 per cent. These figures show that this material can be cold-pressed with comparatively little effort, and that owing to its high ductility it can be so pressed to a very considerable degree. It is claimed that it can be pressed far more than "stainless iron." It can be turned, milled or planed, and also welded by the electrical processes. I am informed that it is not affected by a number of substances which corrode stainless steel—such, for instance, as tartaric acid, citric acid, formic acid, lactic acid and phosphoric acid in all strengths. The class of steels to which this one belongs is produced, I am informed, by alloying a considerable percentage of nickel with a rich content of chromium, and is covered by British patents owned by the Firth-Brearley syndicate. The material is made in the form of sheets, &c., suitable for the ready manufacture of cold-pressed articles requiring no further heat treatment. Its trade name is "Stabrite silver steel." A wide range of utility is anticipated for it, including such purposes as for chemical plant, surgical appliances, valve rings and seatings, cooking and table utensils, spoons and forks, trays, tubes, motor bonnets and fitments, brewery vessels, watch cases, &c.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Position.

THE general state of depression in trade in the North of England is still unrelieved, and little real improvement is now looked for until there is some recovery of our position in foreign markets. In the coal and iron and steel markets our prices are far too high to compete successfully with those on the Continent, whose depressed exchanges give them a big advantage. That, of course, is a difficulty which may be readjusted by the recovery of the exchanges, or more slowly by the gradual advance in continental costs of production, which is bound to come, if the currencies are stabilised at present values. It is a big test of endurance, and Northern commercial people, after three years of depression, are becoming increasingly anxious to catch a glimpse of the sunshine of prosperity once more. As yet, however, there is little on the horizon to inspire hope.

Cleveland Iron Trade.

There is still no substantial change in the state of the Cleveland pig iron trade, which is dull and depressed. A few home buyers have been attracted by the low prices now ruling, and have placed orders for early delivery, but, on the other hand, it is certain that many buyers are simply holding off because every week they see prices moving in their favour. It is the usual thing to make minimum purchases on a falling market, but if only the downward movement were checked and prices stabilised there is a general belief that a fair volume of business would be released. Buyers, however, lack confidence, and sellers, apprehensive of the market moving still further against them, are engaged on a cutting policy which has depressed prices to a totally unprofitable level. Stocks are enormous. Certainly there are accumulated at the works in this district well over 100,000 tons of iron—most of it hematite—and makers are anxious to liquidate. Hence the ever downward trend of prices. Yet with Cleveland prices so low it is almost impossible to obtain export orders. Not only is Cleveland shut out of most of the continental markets, but Belgian iron is actually being sold in Scotland at a figure well below the delivered price of Cleveland foundry iron. No. 3 quality has been sold at 80s. 6d., and that is now regarded as the market quotation, though some sellers are inclined to hold out for 81s. No. 1 is 86s., No. 4 foundry 80s., and No. 4 forge 79s.

Hematite Pig Iron.

The East Coast hematite pig iron trade shows no signs of improvement. The output considerably exceeds the demand, and drastic curtailment cannot be much longer delayed if the market does not improve. The general market quotation for mixed numbers is 89s. per ton, but possibly 6d. less might not be refused for a substantial order.

Ironmaking Materials.

The foreign ore trade is lifeless, consumers having large stocks, and supplies still coming to hand under running contracts. Best Rubio is nominal at 21s. 6d. per ton c.i.f. Tees. Blast-furnace coke is rather cheaper, and good Durham brands can be delivered at the local works for 25s. per ton.

Manufactured Iron and Steel.

There is still a very dull market for manufactured iron and steel. In fact, Belgian billets are coming into the district at a price which is so far below the local cost of production that steel makers are buying them to roll in the local mills. There is a limited flow of specifications

for plates, angles, &c., but the demand is quite insufficient to keep the works fully employed. Sheet makers are busy, having orders in hand to keep them well employed until the turn of the year. Home prices are unchanged, but there is a good deal of under-cutting for overseas business.

The Coal Trade.

The position generally throughout the Northern coal trade shows a better undertone on the whole, but it can only be described as fractionally better. Still there is an improvement on the past week or two, and the placing of a big contract by the Norwegian State Railways has raised hopes of better things in the near future. Prices are believed to range from 18s. 7d. to 18s. 9d. per ton f.o.b., and the contract has only been secured in face of the keenest foreign competition. The prices, however, are regarded as exceedingly low, the market quotation for best steam coal being fully 19s. per ton. This would appear to indicate that if the costs of production could be reduced in this country there would still be a good chance of securing orders when these are available. Of the contract of 50,000 tons, 42,000 tons have been placed with Tyneside exporters direct, and 6000 tons more have been placed through Swedish merchants for Northumberland steams, whilst the remaining 2000 tons have been ordered from South Wales. The delivery is from October to December. The fact, however, cannot be overlooked that this is an isolated order. In other respects the market shows no new features. There is a dearth of trade from most sources, and many merchants are still disposed to take a gloomy view of the outlook, for it is reported that there are large stocks available on the Continent, and the output in this district appears to be on the increase. No more collieries have been laid idle, but thousands of men are out of work in both counties. Until there is some improvement in the industrial demand there appears little hope of any real revival in the coal trade. Prices generally remain steady at about last week's level. The coke trade is inactive. Stocks are ample for all requirements, and supplies are offered freely at late prices.

SCOTLAND.

(From our own Correspondent.)

Clyde Shipbuilding.

At a first glance the tonnage launched on the Clyde for this year to date would apparently indicate a fair state of prosperity on the river. The demand for new craft has been smaller than in normal times, but with a smaller number of men employed than is usual in normal times, the tonnage launched is more than double the amount for the same period last year. A minimum amount of broken and irregular time, lack of local disputes and more harmonious working is largely responsible for the improved returns, which, under different trade conditions, would be distinctly satisfactory. At present the number of shipyard workers on the unemployed list is considerable, and only in the fitting-out departments is there any shortage of labour. New orders are not sufficient to warrant additions to the numbers employed, and the majority, if not all of the shipyards, have considerably fewer men on their books than in pre-war days. New contracts are increasingly difficult to secure. Keen competition from abroad is met with, and owners are still less inclined to contemplate additions to fleets while local costs compare so unfavourably with those quoted from the Continent. During the month of September seventeen vessels of 44,772 tons aggregate were launched on the Clyde, while the figures for this year to date are 165 vessels of 375,657 tons, which compares with eighty-five, of 155,222 tons, in the same period last year. Among the vessels launched were the following:—Inverglas, oil tank steamer, 6920 tons, for the British-Mexican Petroleum Company, London; Asphalian, geared turbine, 6400 tons, for Alfred Holt and Co., Liverpool; Princess Kathleen, 6000 tons, for the C.P.R.; and the Elmworth, 5000 tons, for the Dalgleish Steam Shipping Company, Newcastle-on-Tyne. Chief amongst new contracts reported is one for a 4600-ton motor ship to be built by Barclay, Curle and Co., Whiteinch, for Burns, Philip and Co., Sydney, N.S.W.

Markets Unchanged.

Markets generally have shown little change during the week. Conditions on the whole remain unsatisfactory and unsettled, and neither makers nor consumers are disposed to take the slightest risk. The political situation in relation to German and Russian loans causes considerable anxiety and increases the caution already apparent. Keen competition from German, continental and other sources also makes business more difficult all round, and the general outlook is perhaps even more obscure than formerly.

Steel and Iron.

Steel makers have practically nothing fresh to report. Movements in plates and sections are not showing any tendency towards acceleration, and plants are poorly employed. Home prices are unchanged, but with a good line on offer for export a considerable reduction might be secured. Steel sheets of the lighter gauges, and specially galvanised corrugated varieties, are busy, but makers would welcome orders for the heavier descriptions. Bar iron is poorly bought, makers having difficulty in maintaining a minimum degree of activity. Re-rolled steel is practically in a similar position, only occasional orders being in circulation. Bar iron is unchanged at £12 10s. for Crown bars for home delivery, while re-rolled steel bars can be done at from £9 5s. to £9 10s. per ton home or export. Galvanised corrugated steel sheets, 24 b.g., are firm at £18 10s. per ton f.o.b. Glasgow.

Coal.

The outlook in the coal trade has not improved. The collieries are doing little in the way of foreign business; in fact, it is said that many orders formerly secured at this period of the year are being placed in Germany at greatly reduced prices. Present outputs are going away mainly against old contracts, and a large proportion of the restricted turnover in the market at present is going through second hands. Lanarkshire best splints and navigations, third-class Fifeshire steams, and screened navigations are the descriptions of round fuel maintaining a firm attitude, while treble and double nuts in all districts are busy. All other sorts are poorly placed, and weakening in price. Home demands for industrial purposes are unsatisfactory, but municipal and household requirements are improving. Generally speaking, transactions are of a daily or weekly nature, forward business being still conspicuously absent.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

The conditions in the steam coal trade have not improved, and the outlook is a very dismal one. The foreign demand is not materially better, and, apart from an occasional cargo, there appears to be no disposition to operate. It is not very likely that foreign orders will be on any scale at this period of the year, as no doubt the view will be held that in the present state of trade generally it may be profitable to wait and that supplies over next year may, later on, be arranged at even more favourable prices than those existing. Values ruling at present are round about the level of contract prices for the current year, and in some instances they are even lower, so that the contention of foreign buyers will doubtless be that to induce them to purchase supplies over a considerable period coalowners should make a concession upon present prices. It is questionable whether they will be able to do this in view of their relative high costs, and owners would prefer to go on the hand-to-mouth principle than sell substantial quantities of coal at a figure which would leave them no margin of profit but probably a loss. The position of the collieries at the moment is a very serious one. The number of miners who have received notices to terminate their employment has increased, and there is difficulty at most undertakings in keeping going as the stocks of coal standing are so heavy. In all directions collieries are working very irregularly, and that shipment operations are curtailed will be understood when it is stated that at the beginning of this week there were as many as over 30 loading berths idle at the various ports in this district. Tonnage is short of requirement, which means that collieries cannot get empty wagons to enable them to keep their pits continuously employed. It is only in the anthracite section that the conditions are favourable, as the demand for that coal is quite good and shipments are active.

Unremunerative Collieries.

The Rhondda area appears to be suffering most from the depression existing, and latest accounts show that there are at least 12,000 miners who are dependent upon relief measures instead of work to keep them. In other districts the position is not quite so bad, but it would not be surprising to find an extension of the stoppage of employment at certain collieries in view of the fact that present prices do not pay. Efforts have been continued to persuade the directors of Guest, Keen and Nettlefolds, Limited, to continue the working of the Bedlinog pits, but the latter see no alternative to suspending their operation. The men's leaders have been informed that if they can put forward a proposal which will enable the pits to be worked on an economic basis, then the directors are prepared to give the matter every consideration.

Miners' Agreement.

Considerable surprise was created in this district at the end of last week when the returns were made known regarding the ballot of the workmen in the coalfield on the question of authorising their leaders to sign the Conciliation Board agreement. Previously a delegate conference declined to accept the advice of the leaders that the agreement should be signed, and a ballot of the men throughout the lodges was decided upon. The result of this was 139,750 for and 33,550 against, so that there was a majority of 106,200 for the agreement. These figures show again that the delegate conference decision does not always reflect the feeling of the rank and file. The Executive Council of the South Wales Miners' Federation has resolved to make arrangements for meeting the owners and signing the agreement. Difficulties arising under the anomalies clause of the National Agreement are to be referred to the M. F. G. B., with a view to having them considered by the National Board for the Mining Industry.

Dry Dock Dispute.

Last week there were hopes that a settlement would be come to respecting the dispute between the employers in the dry dock and ship-repairing industry in this district and the members of the Amalgamated Engineering Union, comprising the fitters, coppersmiths, &c. As the result of the intervention of the Ministry of Labour the parties were brought together and a conference took place. The outcome was that it was decided to ballot the men and, although the exact terms of the proposed settlement have not been disclosed, it is believed that they do not differ materially from the conditions which were offered the men at the time that they stopped work. However, it turns out that following on the ballot of the various sections at the different ports and a conference between the leaders and the employers nothing has come of the movement for bringing peace. It is known that the ballot of the workmen showed a majority against the employers' terms.

Current Business.

The conditions all round have been again quiet and prices are, if anything, lower than they were last week. This applies both to large and small coals. The market is extremely irregular, and prices bear very little relationship to one another despite the similarity of the coal. Everything depends upon the immediate position of the undertaking. Out of an inquiry from the Norwegian State Railways for 50,000 tons of steam coals from this country for delivery over the next three months, only the small quantity of 2000 tons has been placed for Welsh coal, the price being 27s. 6d. f.o.b. double-screened. There was recently an inquiry from South America for 300,000 tons of steam coals, but the report was current that part of the order amounting to 175,000 tons, had been secured by Germans. These coals were for delivery over a period of twelve months from early next year.

CATALOGUES.

British Insulated and Helsby Cables, Limited, Prescot, Lancs.—A copy of the B.I. pocket catalogue.

Petters Limited, Westland Works, Yeovil.—A catalogue of the Petter surface ignition type cold starting oil engines.

Sulzer Brothers, Limited, 31, Bedford-square, W.C. 1.—A catalogue of the Sulzer two-cycle Diesel marine engine.

H. C. Slingsby, Limited, Kingsway, W.C. 2.—List No. 242 illustrating and describing the uses of the Slingsby jacklift.

Alfred Herbert, Limited, Coventry.—New publication entitled "Accurate Measurement and its Commercial Value."

David Carlaw and Sons, Limited, 31, Finnieston-street, Glasgow.—Illustrated pamphlet on elevators and conveyors.

Ruston and Hornsby, Limited, Lincoln.—A catalogue describing and illustrating the Ruston vertical cold starting oil engine.

Trollope and Colls, Limited, 5, Coleman-street, E.C. 2.—A bulletin on viaducts and bridges, together with estimates of their cost.

Cochran and Co., Annan, Limited, Annan, Scotland.—A new pamphlet on the utilisation of waste heat in connection with the Cochran boiler.

Marshall, Sons and Co., Limited, Gainsborough.—Publication No. 1459 on the Marshall portable and semi-portable steam engines, Class "S."

Crofts (Engineers), Limited, Thornbury, Bradford.—A booklet illustrating and describing worm reduction gears manufactured by the firm.

Hyatt Limited, 56, Victoria-street, S.W. 1.—Leaflet of the Hyatt bearing, clutch and constant-mesh spigot positions and gear-box main shafts.

Mavor and Coulson, Limited, 47, Broad-street, Mile End, Glasgow.—The eleventh edition of the M. and C. coal cutter catalogue, illustrating bar, chain and disc coal cutters.

Joshua Heap and Co., Limited, Ashton-under-Lyne.—A circular giving particulars of the automatic bolt screwing machines fitted with the firm's patent tangential die head.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Weston Electrical Instrument Company, Limited, has removed its offices and laboratory to 15, Great Saffron-hill, London, E.C. 1.

James Gordon and Co., Limited, of Windsor House, Kingsway, London, advise us that they have recently opened a branch office at 110, Waterloo-street, Glasgow, under the management of Mr. A. D. Burgess.

The Beldam Packing and Rubber Company, Limited, of 29, Gracechurch-street, London, E.C. 3, asks us to state that its telephone numbers have been altered from Avenue 5204 and 1982 to Royal 5161 (3 lines).

Flannery, Baggallay and Johnson, Limited, of 9, Fenchurch-street, and 2 and 3, Philpot-lane, London, E.C. 3, ask us to state that owing to Post Office arrangements their telephone service of their London office has been transferred from Avenue to Royal Exchange, and that their telephone numbers are now Royal 4762 and 4763.

We are asked to state that the name of F. R. Rand and Co., Limited, of 38, Victoria-street, Westminster, London, S.W. 1, has been changed to G. H. Sheffield and Co. (Engineers) Limited. The board of directors is as follows:—G. H. Sheffield, A.M. Inst. C.E., M. Inst. Mech. E., F. L. Lane, O.B.E., M. Inst. Mech. E., Sir T. Cato Worsford, Bart., M.A., LL.D., D.L.

Mr. Harry Allcock has joined the board of Royce, Limited, Trafford Park, Manchester. Mr. Allcock's long association with the cable making firm of W. T. Glover and Co., Limited, remains unaffected by this further appointment. It will be recalled that the Rolls-Royce Company owed its birth to Royce, Limited. Mr. F. Henry Royce, we are informed, will continue to act as the consulting technical expert for both these concerns, of which he was the founder.

CONTRACTS.

The Electric Furnace Company, Limited, of 17, Victoria-street, London, S.W. 1, has recently supplied complete equipment for the melting of metals by high-frequency electrical currents to a leading German firm of wire manufacturers.

In connection with the extensions which are now taking place at the Lake Coleridge hydro-electric power station of the New Zealand Government, Bruce Peebles and Co., Limited, Edinburgh, have secured the contract for the supply of the two 7500-kilowatt alternators, each complete with direct-coupled exciter. The alternators are to generate three-phase 50-cycle current at a pressure of 6600/7000 volts when driven at a normal speed of 500 revolutions per minute.

The Vickers and International Combustion Engineering, Limited, has closed a contract for the power plant of a large flax mill in Belfast, owned by the York-street Flax Spinning Company, Limited. The contract is for the complete design and erection of all buildings, coal-handling plant, boilers and furnaces, burners, &c. The boilers are of the Babcock and Wilcox type, each having 9270 square feet heating surface, and the pulverising plant is of the "Lopulco" type.

Henry Berry and Co., Limited, hydraulic engineering specialists, Leeds, have been awarded the contract by Dorman, Long and Co., Limited, for the whole of the hydraulic machinery to be used in constructing the Sydney Harbour Bridge. In addition to this contract, Messrs. Berry have just received an order for a large extruding press from one of the largest extruding firms in the world. They have recently supplied several cotton baling plants to India and have several other sets under construction.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	17/6 to 24/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c. ...)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 15 0	—
No. 1 Foundry	4 15 0	—
No. 3 Foundry	4 10 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 9 0	4 9 0
No. 1	4 9 6	4 9 6
Cleveland—		
No. 1	4 6 0	4 6 0
Silicious Iron	4 6 0	4 6 0
No. 3 G.M.B.	4 0 0	4 0 0
No. 4 Foundry	3 19 6	3 19 6
No. 4 Forge	3 19 0	3 19 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 2 0	—
„ „ Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	4 0 0	
„ Forge	3 15 0	—
(3) Derbyshire—		
No. 3 Foundry	4 3 0 to 4 4 0	
Forge	3 17 6	—
(3) Lincolnshire—		
No. 3 Foundry	4 10 0 to 4 12 0	
No. 4 Forge	4 12 6 to 4 15 0	
Basic	4 5 0 to 4 10 0	
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 5 0 (a)	—
	5 10 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 10 0	—
Best „	—	—
N.E Coast—		
Common Bars	12 10 0	—
Lancs —		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	13 10 0	—
Best „	14 0 0	—
Hoops	15 0 0	—
Midlands—		
Crown Bars	12 15 0 to 13 0 0	
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	—
Gas Tube Strip	13 5 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 10 0	—
Ship Plates, ¼in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 15 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
Manchester—		
Bars (Round)	10 5 0 to 10 15 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
„ (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	
Intermediate Basic	9 0 0	
Soft Basic	8 0 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
Midlands—		
Small Rolled Bars	9 7 6 to 10 0 0	
Billets and Sheet-bars	7 10 0 to 7 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 2 6 to 18 5 0	
Angles	9 10 0 to 10 0 0	
Joists	9 10 0 to 10 0 0	
Tees	10 10 0 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/6 to 23/7½
Block Tin (cash)	239 5 0
„ (three months)	241 5 0
Copper (cash)	62 5 0
„ (three months)	63 5 0
Spanish Lead (cash)	33 2 6
„ (three months)	32 15 0
Spelter (cash)	32 12 6
„ (three months)	32 12 6
Manchester—	
Copper, Best Selected Ingots	67 10 0
„ Electrolytic	68 10 0
„ Strong Sheets	92 0 0
„ Tubes (Basis price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
„ Condenser	0 1 2
Lead, English	35 10 0
„ Foreign	34 0 0

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
„ 6 p.c. to 8 p.c. „	£23 10 0	7/9
„ 8 p.c. to 10 p.c. „	£23 0 0	7/6
„ Specially Refined		
„ Max. 2 p.c. carbon	£43 0 0	16/-
„ „ 1 p.c. „	£52 0 0	17/6
„ „ 0.75 p.c. carbon	£60 0 0	20/-
„ „ carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0	scale 5/- per unit
„ „ 75 p.c.	£17 17 6	scale 6/- per unit
„ Vanadium	16/3 per lb.	
„ Molybdenum	7/9 per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£155	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	17/9
„ „ Ell	19/6
„ „ Splint	21/6 to 24/-
„ „ Trebles	21/6
„ „ Doubles	17/9
„ „ Singles	14/3
Ayrshire—	
(f.o.b. Ports)—Steam	17/9
„ „ Splint	21/6
„ „ Trebles	21/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	16/- to 18/6
Screened Navigation	26/6
Trebles	24/-
Doubles	19/-
Singles	14/9
Lothians—	
(f.o.b. Leith)—Best Steam	17/6
Secondary Steam	16/9
Trebles	23/-
Doubles	19/9
Singles	14/9

ENGLAND.

	Inland.
(8) N.W. Coast—	
Steams	28/6
Household	45/- to 58/4
Coke	32/6
Northumberland—	
Best Steams	18/9 to 19/-
Second Steams	17/6 to 18/-
Steam Smalls	10/9 to 11/-
Unscreened	15/6 to 17/-
Household	23/6 to 25/-
Durham—	
Best Gas	21/6 to 22/-
Second	17/- to 18/-
Household	23/6 to 25/-
Foundry Coke	25/6
Sheffield—	
Best Hand-picked Branch	32/- to 35/- —
Barnsley Best Silkstone	26/- to 28/- —
Derbyshire Best Brights	26/- to 28/- —
„ „ House	23/- to 25/- —
„ „ Large Nuts	21/- to 25/- —
„ „ Small „	13/- to 15/6 —
Yorkshire Hards	20/6 to 22/- —
Derbyshire „	20/- to 21/6 —
Rough Slacks	12/6 to 15/6 —
Nutty „	12/- to 14/- —
Smalls	6/- to 8/6 —
Blast-furnace Coke (Inland)*	— —
„ „ (Export)	f.o.b. 25/- to 25/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	27/- to 27/6
Second „ „	25/6 to 26/6
Best Dry Large	26/- to 27/-
Ordinary Dry Large	25/- to 26/-
Best Black Vein Large	25/- to 25/6
Western Valley „	24/- to 25/-
Best Eastern Valley Large	24/- to 25/-
Ordinary „ „	23/- to 24/-
Best Steam Smalls	15/- to 16/-
Ordinary „	13/- to 15/-
Washed Nuts	25/- to 27/-
No. 3 Rhondda Large	27/- to 27/6
„ „ Smalls	19/- to 20/-
No. 2 „ Large	23/- to 24/-
„ „ Through	18/- to 20/-
„ „ Smalls	11/- to 13/-
Foundry Coke (export)	45/- to 52/6
Furnace Coke (export)	27/6 to 32/6
Patent Fuel	26/- to 28/6
Pitwood (ex ship)	28/6 to 29/6
Swansea—	
Anthracite Coals	
Best Big Vein Large	52/6 to 55/-
Seconds	45/- to 47/6
Red Vein	33/- to 35/-
Machine-made Cobbles	60/- to 62/6
Nuts	55/- to 62/6
Beans	40/- to 42/6
Peas	24/- to 26/-
Breaker Duff	11/- to 11/6
Rubbly Culm	12/6 to 13/-
Steam Coals:	
Large	22/6 to 23/6
Seconds	22/- to 22/6
Smalls	14/- to 16/-
Cargo Through	17/- to 19/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast furnaces only, 16/9, with fluctuations according to analysis; open market, round about 22/6 to 25/- at ovens. † Latest quotations available. (*a*) Delivered Sheffield or Glasgow. (*b*) Delivered Birmingham.

French Engineering Notes.

(*From our Correspondent in Paris.*)

The Situation.

THE mills and forges find it difficult to secure orders at a time when consumers limit purchases to pressing needs in the belief that the situation will turn in their favour, and producers themselves are so uncertain as to the future that they are disposed to offer concessions with a view of overcoming the hesitation of buyers. The settlement of the problem of tariffs and commercial treaties, as well as of the conditions under which France and Germany are to collaborate in an exchange of coke and iron ore, promises to drag along for so considerable a time that producers cannot afford to wait indefinitely. They are therefore more disposed to adapt themselves to present conditions than to wait and see what the future will bring forth, and the need for work is compelling them, in many cases, to make special offers for large orders. It would appear that prices have reached high-water mark, unless the industry should be burdened by additional charges, and rolled iron and steel are now obtainable under easier conditions. The critical financial position, which is becoming steadily worse, is also having the effect of compelling makers to reduce stocks by realising as much as they can. In view of the necessity of looking more and more to foreign markets it is proposed to revive the various "comptoirs" for regulating sales abroad, but nothing can be done in this direction until the various questions affecting prices, such as tariffs, commercial treaties, and the cost of coke, is settled.

Reconstruction.

Since the Government suspended payments for reconstruction in the devastated areas, work has been practically at a standstill. So far as the industrial reconstruction is concerned there is little remaining to be done, and the rebuilding of old factories with modern equipments has permitted of a far greater and more economical production than before the war. No one attempts to deny that there have been abuses in the distribution of funds for reconstruction, but as the Government was obliged to issue certificates redeemable at certain dates there was an unavoidable speculation which frequently called for official intervention. Now that the Government is no longer able to redeem the certificates, the contractors, who have usually made a very good thing out of the reconstruction work, will do nothing further, and the devastated regions have ceased for the moment to be a factor in the industrial activity.

Paris Water Supply.

By the completion of the aqueduct from the sources of the Voulzie and Durteint, near Provins, which was commenced towards the end of 1922, the supply of water to Paris has been increased by 80,000 cubic metres—say, 17,600,000 gallons—a day. Reinforced concrete conduits carry the water as far as Longueville, where it is pumped into cast iron mains which join the big Loing and Lunain aqueduct in the Forest of Fontainbleau. The diameter of the new cast iron mains is 1.25 m. and they have a length of 47.87 kiloms. At Longueville the water is raised to a height of about 66 m. by means of seven Renault-Diesel engines and Rateau pumps, each of 400 horse-power. As practically the whole of the water of the Voulzie and Durteint is diverted from the sources, provision has had to be made for returning an equivalent volume of water to those rivers, and that is done by taking water from the Seine near Bray-sur-Seine and pumping it through nearly 13 kiloms. of cast iron mains, 1.25 m. diameter, by means of four Faure-Beaulieu-Diesel engines and Rateau pumps. The water has to be raised to a height of about 44 m. The total cost of the work was 80 million francs. The needs of Paris are growing so rapidly that scarcely is one scheme for increasing the supply of water completed than it is overtaken, and the immediate carrying out of other works is only prevented by financial considerations. There are other small sources to be tapped and filtering beds to be constructed, but it is considered that Paris will never have a supply sufficient to meet all emergencies until it is allowed to tap the Vals de Loire or construct the huge barrage on the upper reaches of the Seine which would supply the city with water and at the same time regulate the flow of the river.

Railwaymen.

During the great railway strike of about three years ago many thousands of men were discharged through failing to return to work within the time allotted, and since then the Socialists have made the reinstatement of these men a plank of their platform. Each succeeding Government has had to resist the pressure brought to bear upon it in favour of the men. It became a matter of principle whether or not the companies were to remain masters of the railways. Now that a Socialist Government is in power the railway companies have received orders to reinstate the men. On the State railways the orders have been obeyed, although less than a third of the original number have presented themselves, the remainder apparently having found more lucrative situations in the meanwhile. The other railway companies refuse absolutely to take back the men on the ground that they are alone able to judge whether it is expedient to do so, and they are of the opinion that in deferring to the orders of the Government they would be introducing turbulent elements that might cause trouble in the future. The Minister of Public Works has announced his intention of taking whatever measures may be necessary to compel the companies to reinstate the men, the majority of whom have probably no desire to return, and he goes so far as to threaten the companies with the possibility of the railways being taken over by the State. In all this there is no reference to the Conseil Supérieur des Chemins de Fer, which should obviously have a voice in the matter. That controlling body seems to have been shelved by the Government, which is trying to exercise its old authority over the railways, but in the case of the discharged railwaymen the firm and uncompromising attitude of the railway companies is disconcerting to the Minister of Public Works.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

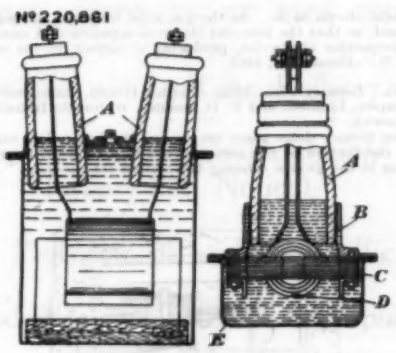
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TRANSFORMERS AND CONVERTERS.

220,861. November 28th, 1923.—IMPROVEMENTS IN OR RELATING TO OIL-INSULATED ELECTRIC TRANSFORMERS, Sachsenwerk, Licht-und Kraft Aktiengesellschaft, of Niedersedlitz, near Dresden, Germany, Willy Sarfert, of 22, George Bährstrasse, Dresden, and Friedrich Häberle, of 32, Fillnitzerstrasse, Zschieren, near Dresden.

According to this invention a special expansion chamber for the oil in a transformer is unnecessary, the invention being more particularly applicable to small transformers, such as measuring

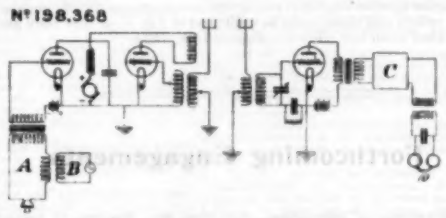


transformers. The left-hand drawing represents a voltage transformer in which the leading-in insulators A are used as expansion chambers for the oil. The right-hand drawing shows a current transformer arrangement in which the leading-in insulator A is also used as an expansion chamber. Another advantage of this arrangement is that the leading-in insulator filled with oil or the insulator holder B is itself used as the main oil vessel for the whole or a part of the winding D. The iron core C is secured to the lid of the oil vessel E.—*August 28th*, 1924.

TELEGRAPHS AND TELEPHONES.

198,368. May 25th, 1923.—IMPROVEMENTS IN RADIO TELEPHONY, *Marconi's Wireless Telegraph Company, Limited, of Marconi House, Strand, W.C.* 2.

This invention is a somewhat extraordinary one. The object is to prevent owners of wireless receiving sets, who do not contribute towards the upkeep of broadcasting stations, receiving the transmissions of those stations. Briefly, it is proposed to add to the outgoing music or speech powerful interfering tones which would distort the transmission and which would spoil the quality of reception in an ordinary



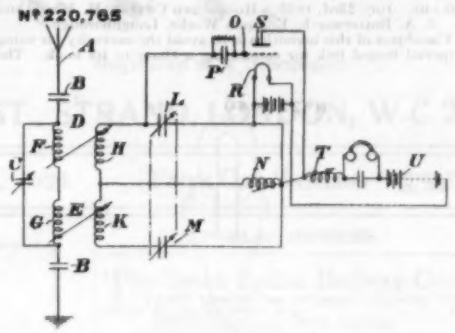
receiver. In special sets which the public would apparently purchase, however, the interfering tone would be eliminated by means of filters. In the left-hand diagram A is a telephone circuit for impressing the speech or music on the high-frequency transmitting circuits, and the source of interference is shown at B. The receiver is shown in the right-hand diagram in which the electrical filter for getting rid of the interference is shown at C.—*August 21st*, 1924.

220,388. May 17th, 1923.—IMPROVEMENTS IN OR RELATING TO THERMIONIC VALVES AND CIRCUITS THEREOF, James Robinson and Walter Howley Derriman, of the Royal Aircraft Establishment, South Farnborough, Hampshire.

A three-electrode thermionic valve has the grid and the anode each made in the form of an inductance, and each is provided with a pair of separate terminals, the grid and the anode being arranged to provide a magnetic coupling between them, whilst the terminals allow circuit connections to be made to each end of the grid and anode. When the grid and anode are connected in a circuit in which the grid and anode circuits require to be magnetically coupled no external coupling need be provided, or only such external coupling may be used as is necessary to allow of variations in the total coupling. The improved valve may be used as a power valve or generator valve, a detector or as an amplifying valve.—*August 18th*, 1924.

220,765. June 27th, 1923.—IMPROVEMENTS RELATING TO WIRELESS RECEIVING CIRCUITS, Norman Pullen Hinton, of Alberville, Highfield-road, Golders Green, N.W. 11, and the Metropolitan-Vickers Electrical Company, 4, Central-buildings, Westminster, S.W.

The object of this invention is to enable reaction to be used in a wireless receiving set without causing radiation from the aerial. In the drawing the aerial is shown at A in series with fixed condensers B, and having an adjustable condenser C in parallel with its inductance. High-frequency transformers D and E have their respective primary windings F and G connected in series in the same sense in the aerial circuit to form the aerial inductance. The two secondary windings H and K are connected in series in the same sense and their free ends connected through two condensers L and M, which are mechanically coupled so as to be simultaneously and similarly adjustable. The junction of the two secondary coils is connected to the conductor joining the common plate of the condensers L and M through an inductance N the value of which is small compared with that of the two secondary coils of the transformers. The two plates of the condenser L in the oscillatory circuit thus formed are connected, as shown, to a three-electrode valve. One plate is connected to the grid O of the valve through a condenser P, which can be shunted by the usual grid leak. The other plate

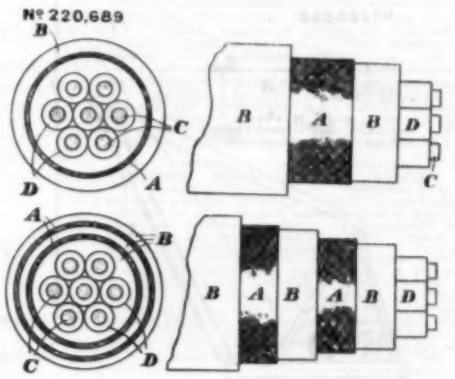


of the condenser L is connected to the filament R of the valve. The circuit from the anode S of the valve comprises an inductance T in series with the telephones and a high-tension battery U. The two inductance coils T and N can be electro-magnetically coupled so that reaction is introduced between the anode and grid circuits of the valve.—*August 28th*, 1924.

TRANSMISSION OF POWER.

220,689. April 23rd, 1923.—IMPROVEMENTS IN ELECTRIC CABLES, Frederick Harry Broomfield, 69, Taylor-road, Wallington, Surrey, and Nathan John Austin, 37, Carholme-road, Forest Hill, S.E. 23.

The invention relates to flexible single or multi-core electric cables of the type known as "cab tire" or tough rubber-sheathed cables in which mechanical protection is afforded by a sheathing of rubber or rubber compound. According to the invention, canvas or other suitable fabric, without open spaces or interstices, preferably proofed on each side with rubber or compound rubber,

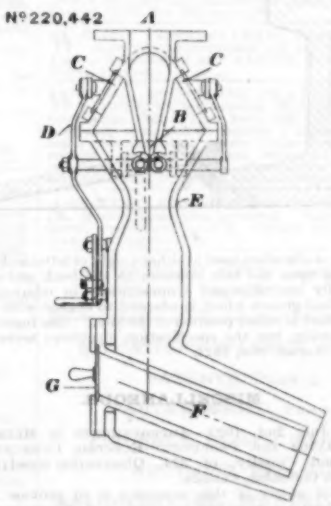


is applied in a longitudinal machine as a continuous sheet between two protective sheaths of rubber compound. The seams of the sheet, which form a butt or lap joint, are then pressed together and the whole vulcanised. Referring to the upper drawing, the conductors C are covered in the usual manner with an insulating material D. B is the rubber, tough rubber or cab tire sheathing, and A is the reinforcing material of canvas, proofed on each side in known manner with rubber or rubber compound and applied longitudinally. In the example in the lower drawing an additional layer of canvas A is inserted between the rubber sheathings B.—*August 20th*, 1924.

FURNACES.

220,442. July 24th, 1923.—ATMOSPHERIC BURNERS, J. E. Weyman, *Pilgrim House, Pilgrim-street, Newcastle-on-Tyne.*

This burner is intended for coke oven, producer or such like gas, and is of rectangular form. The gas inlet is at A and



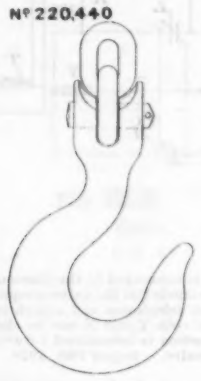
extends into the enlarged upper part of the burner to a narrow slit B. The width of this slit can be adjusted by means of two sector-shaped pieces. The primary air inlet ports are at C C, and the air can be regulated by shutters operated by the linkwork D. Below the gas orifice the body of the burner is con-

tracted to form a neck E. Secondary air is admitted by the passage F with a regulator G. This passage also provides a convenient means for lighting the burner.—*August 21st*, 1924.

CRANES AND CONVEYORS.

220,440. July 23rd, 1923.—Hooks and Chains, H. Morris and J. A. Butterworth, Empress Works, Loughborough.

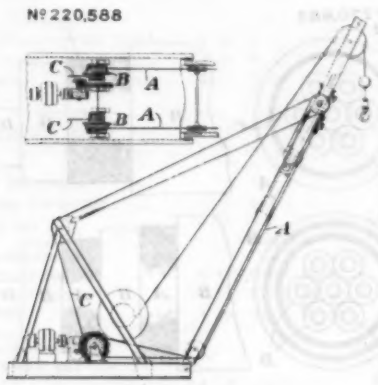
The object of this invention is to avoid the necessity for using a special forged link for connecting a chain to its hook. The



hook is formed with two lugs, as shown in the illustration, which fit the last link snugly and are cut away to clear the next link. An oval pin is used to attach the chain to the hook.—*August 21st*, 1924.

220,588. April 15th, 1924.—Horizontal Luffing Cranes, Thomas Smith and Sons (Rodley), Limited, and E. Fawcett Rodley, Leeds.

With this crane horizontal movement of the load during the luffing of the jib is secured by making the outer end of the jib, which carries the hoisting rope sheave, to telescope in the main

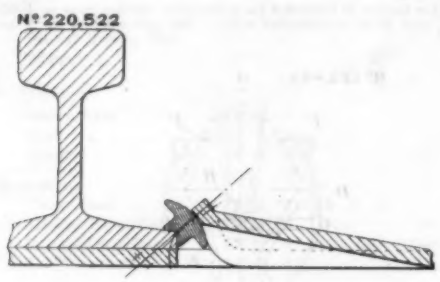


part of the jib. The telescoping extension is held by the ropes A A, which are wound on drums B B keyed to the same shaft as the drums for the luffing ropes C C. The drums B B are so proportioned as to cause the jib to extend or contract, as it is luffed out or in, to such an extent that the load travels horizontally.—*August 21st*, 1924.

TRAMWAYS AND RAILWAYS.

220,522. November 17th, 1923.—Rail Keys, J. P. Bayley, Ty-Gwyn, 4, Westfield-road, Newport, Mon.

The inventor claims that his form of key, for use with metal sleepers, can not only be used right or left-handed, but also can be easily made by rolling. The principal claim says that it should have "a back shaped to suit the internal surface of the

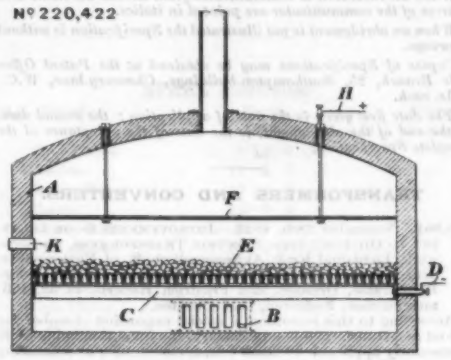


sleeper lug or clip when used in either a right or left-hand position, and having upon the side opposite to the back and arranged substantially centrally and symmetrically in relation thereto a longitudinal groove which is adapted to engage with the edge of the rail foot in either position of the key." One form is shown in the drawing, but the specification illustrates several modifications.—*August 21st*, 1924.

MISCELLANEOUS.

220,422. July 2nd, 1923.—Improvements in Method and Apparatus for Producing Electric Currents, Cecil Edmund Crossley, of 324, Observation-street, Nelson, British Columbia, Canada.

The main object of this invention is to provide a means whereby electric current can be simply and efficiently produced by the ionisation of gases produced in a furnace in which combustible material is being burned. A is the furnace, which is provided with a damper door B. The grate is supported on a metallic ring C, with an electrical connection at D. On the grate a mass of combustible material E is placed. Above the furnace there is a metal plate F with an electrical connection H. The grate acts as the anode, whilst the plate F acts as the cathode. The gases in the space between the anode and cathode are ionised by cathode rays, X rays, ultra violet rays, or rays of a similar nature, these rays being produced by a suitable



apparatus shown at K. As the gas rises from the furnace, it is ionised, so that the ions and electrons separate and move to their respective electrodes, producing a current in the wires D and H.—*August 21st*, 1924.

220,231. January 25th, 1924.—Sluice Gates, Ransomes and Rapier, Limited, and P. D. Ionides, Waterside Ironworks, Ipswich.

When Stoney sluice gates are opened the live rollers extend below the bottom of the gate and are thus exposed to water eddying in the groove forming the setting for the gate. As a

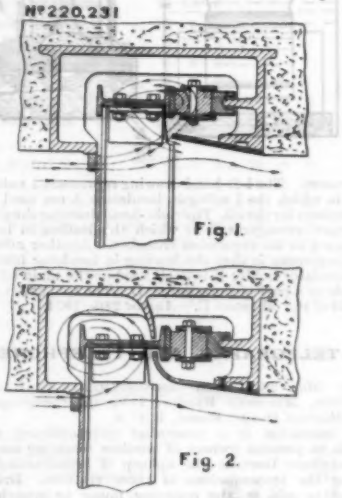


Fig. 1.

Fig. 2.

result vibration is sometimes set up and the moving parts are damaged. Such a condition of affairs is illustrated by Fig. 1. In order to overcome the trouble the inventors practically enclose the rollers and their path, as indicated in Fig. 2, so that they are shielded from the eddies.—*August 14th*, 1924.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Diesel Engine Users' Association.—The Engineers' Club, Coventry-street, London, W. 1. Paper, "The Significance of Exhaust Temperature," by Mr. P. H. Smith. 3.30 p.m.

Institution of Mining Engineers.—British Empire Exhibition, Wembley. Thirty-fifth annual general meeting.

Junior Institution of Engineers.—39, Victoria-street, London, S.W 1. Lecture, "Explosions, Terrestrial and Celestial," by Professor A. W. Bickerton. 7.30 p.m.

TO-DAY and till WEDNESDAY, OCTOBER 8th.

All British Radio Exhibition.—Royal Albert Hall, London, S.W. 7.

SATURDAY, OCTOBER 4th.

Institute of British Foundrymen: Lancashire Branch.—College of Technology, Sackville-street, Manchester. Presidential address by Mr. R. A. Miles. Paper, "John Wilkinson," by Mr. J. P. Bedson. 4 p.m.

Keighley Association of Engineers.—Visit to the works of the Yorkshire Iron and Coal Company at Ardsley. Train leaves Keighley at 12.5 p.m.

MONDAY, OCTOBER 6th.

Bradford Engineering Society.—Technical College, Great Horton-road, Bradford. "A Visit to the Redcar Steel Works," by the President, Mr. L. Baldwin. A film showing the electrically-driven plant at the Middlesbrough and Redcar Works of Dorman, Long and Co. will be shown. 7.30 p.m.

Institute of Transport.—Institution of Electrical Engineers, Savoy-place, London, W.C. 2. Presidential address by Sir Lynden Macassey. 5.30 p.m.

Junior Institution of Engineers: North-Western Section.—Manchester Geographical Society's Rooms, 16, St. Mary's Parsonage, Manchester. Annual general meeting. Address, "Triumph over Difficulties," by the Chairman. 7.15 p.m.

Society of Engineers.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "Pulverised Fuel," by Mr. E. Kilburn Scott. 5.30 p.m.

TUESDAY, OCTOBER 7th.

Institute of Metals: Birmingham Local Section.—Chamber of Commerce, New-street, Birmingham. Address by the Chairman, Mr. W. R. Barclay. 7 p.m.

Institute of Metals: North-East Coast Local Section.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "The Structure of Metals in its Relation to Elastic Failure—Part I.," by Professor F. C. Thompson. 7.30 p.m.

Institution of Petroleum Technologists.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Recent Development in the Art of Cracking," by Dr. A. E. Dunstan. 5.30 p.m.

WEDNESDAY, OCTOBER 8th.

Institute of Patentees.—The Engineers' Club, Coventry-street, London, W. 1. Lecture, "What not to Invent," by Professor P. M. Baker. 8 p.m.

Institution of Engineers-in-Charge.—St. Bride Institute, Bride-lane, London, E.C. 4. Paper, "The Testing of Aero-Engines in Flight," by Mr. R. J. Penn. 7.30 p.m.

Institution of Sanitary Engineers.—The Cabin Restaurant, Caxton House, Tothill-street, London, S.W. 1. Opening sessional meeting. 7.30 p.m.

Newcomen Society.—Iron and Steel Institute, 28, Victoria-street, London, S.W. 1. Papers, "A Sketch of the Industrial History of the Coalbrookdale District," by Mr. Rhys Jenkins; "The Discoveries of the Darbys of Coalbrookdale," by Mr. T. S. Ashton; "Notes on Coalbrookdale and the Darbys," by Mr. John W. Hall. 5.30 p.m.

THURSDAY, OCTOBER 9th.

Institute of Metals: London Local Section.—Institute of Marine Engineers, 85/88, The Minories, London, E. 1. Address by the Chairman, Dr. J. L. Haughton. 7.30 p.m.

FRIDAY, OCTOBER 10th.

Institute of Metals: Sheffield Local Section.—Mappin Hall, The University, St. George's-square, Sheffield. Address by the Chairman, Mr. W. G. Turner. 7.30 p.m.

Institute of Metals: Swansea Local Section.—Metallurgical Department of the University, Singleton Park, Swansea. Address by the Chairman, Captain Hugh Vivian. 7.15 p.m.

Junior Institution of Engineers, 39, Victoria-street, London, S.W. 1. Paper, "The Design of Static Sub-Stations, with some Notes on their Equipment," by Mr. N. Thornton. 7.30 p.m.

SATURDAY, OCTOBER 11th.

Institution of Municipal and County Engineers.—South Western District Meeting at Truro. 1.45 p.m.

MONDAY, OCTOBER 13th.

Institute of Metals: Scottish Local Section.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Chairman's address, with some notes on "Brass Foundry Costing," by Mr. John Stirling. 7.30 p.m.

Institute of Transport: Midland Local Section.—Chamber of Commerce, New-street, Birmingham. Address by Sir Herbert Austin, Chairman of the Midland Local Section. 6 p.m.

TUESDAY, OCTOBER 14th.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Municipal College, Burnley. Open discussion on "Some Foundry Problems," to be opened by Mr. J. Hogg. 7.15 p.m.

FRIDAY, OCTOBER 17th.

Junior Institution of Engineers.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Lecture, "High-voltage Electric Oscillations," by Mr. R. P. Howgrave-Graham. 7.30 p.m.

FRIDAY to SATURDAY, OCTOBER 17th to 25th.

Society of Motor Manufacturers' and Traders' Exhibition at Olympia. 10 a.m. each day.

MONDAY, OCTOBER 20th.

Junior Institution of Engineers: North-Western Section.—Manchester Geographical Society's Rooms, 16, St. Mary's Parsonage, Manchester. Paper, "Powdered Fuel," by Mr. G. E. Blyth. 7.15 p.m.

TUESDAY, OCTOBER 21st.

Institute of Marine Engineers.—85/88, The Minories, Tower Hill, London, E. 1. "Present Tendencies in Steam Generation," by Sir James Kemnal. 6.30 p.m.

FRIDAY, OCTOBER 31st.

Institute of Marine Engineers.—Hotel Cecil, Strand, London, W.C. 2. Annual Dinner. 6.30 p.m.

The Institution of Civil Engineers.—The Council of the Institution of Civil Engineers has made the following awards in respect of selected engineering papers published without discussion during the session 1923–1924:—A Telford Gold Medal to Mr. E. H. Lamb, D.S.C., M.Sc., Assoc. M. Inst. C.E. (London); Telford and Indian Premiums to Mr. F. C. Temple, M. Inst. C.E. (Jamshedpur, India); and Telford Premiums to Mr. H. A. Lewis-Dale, M. Inst. C.E. (London); Professor Louis N. G. Filon, D.Sc., F.R.S. (London); and C. J. Gyde, M. Inst. C.E. (Pretoria); and in respect of papers read at students' meetings in London or by students before meetings of Local Associations during the same period:—The James Forrest Medal, the James Prescott Joule Medal and a Miller Prize to Mr. R. W. Mountain, B.Sc., Stud. Inst. C.E. (London); and Miller Prizes to Messrs. H. S. Smith, B.Sc., Stud. Inst. C.E. (London); and C. D. Crosthwaite, B.Sc., Stud. Inst. C.E. (London); H. C. Toy, B.Sc., Stud. Inst. C.E. (Birmingham); F. W. S. Hawtayne, B.Sc., Assoc. M. Inst. C.E. (London); E. G. Wilson, Stud. Inst. C.E. (North Shields); and W. W. Davies, B.Sc., Stud. Inst. C.E. (London).